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ABSTRACT

This paper reports information received from responses to a survey questionnaire from the presidents of 46 universities and their affiliated colleges across Canada. The questionnaire (circulated to all member institutions of the Association of Universities and Colleges of Canada) included queries about the experiences of the universities with communications and information technologies, and about the use of computer technology as a research tool in libraries and for distance education. The first section reports on use of the established technologies of film, television, videotape, radio, and audiotape. The second section explores the uses of computer technologies for instruction, research, networking, and conferencing. Comments on potential changes in higher education resulting from new technologies are discussed in the final section. The research questionnaire and list of responding colleges are provided. (DB)

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NEW TECHNOLOGIES IN CANADIAN EDUCATION

PAPER 4

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COMMUNICATIONS AND INFORMATION TECHNOLOGIES IN CANADIAN UNIVERSITIES

By Thelma Rosen

Study Coordinator
Ignacy Waniewicz

August 1984

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NEW TECHNOLOGIES IN CANADIAN EDUCATION

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Paper 2	Communications and information technologies in Canadian elementary and secondary schools
Paper 3	Communications and information technologies in community colleges in Canada
Paper 4	Communications and information technologies in Canadian universities
Paper 5	Communications and information technologies and distance education in Canada
Paper 6	Communications and information technologies and the education of Canada's native peoples
Paper 7	The provincial educational communications organizations in Canada
Paper 8	Educative activities of the Canadian Broadcasting Corporation and the National Film Board of Canada
Paper 9	Applications of new technologies in nonformal adult education in Canada: Two examples
Paper 10	Canadian cable television and education
Paper 11	Educational applications of videotex/Telidon in Canada
Paper 12	Educational applications of communications satellites in Canada
Paper 13	Educational videodisc in Canada
Paper 14	Educational teleconferencing in Canada
Paper 15	Telehealth: Telecommunications technology in health care and health education in Canada
Paper 16	The high technology industry and education in Canada
Paper 17	New technologies in education in Canada: Issues and concerns

Copies of these papers can be purchased from TVOntario, Box 200, Station Q, Toronto, Ontario, Canada M4T 2T1.

FOREWORD

We dedicate this series to its designer and director, Ignacy Waniewicz. His death on February 21, 1984, has left us with a feeling of immeasurable loss.

With uncanny intelligence, instinct, and energy, Ignacy introduced the first educational television programs in his native Poland in 1957 and rose to the position of Director of Educational Broadcasting. During the mid-1960s, he served as a Paris-based program specialist in the educational use of radio and television, working for UNESCO in Chile, Cuba, Ivory Coast, Upper Volta, Mexico, Egypt, Nigeria, Senegal, Ghana, Great Britain, United States, Switzerland, and Israel. Ignacy shared the experience and insight he gained from this work by teaching and writing in Polish, German, Russian, Hebrew, Spanish, French, and English. His achievements are widely recognized in the broadcasting and academic communities on four continents.

As Director of the Office of Development Research at TVOntario, Ignacy explored his farsighted and consuming interests in adult education, media literacy, television as a primary tool for lifelong learning, and most recently, the educational uses of new technologies. His work did much to shape and guide TVOntario's progress over the last 15 years.

It is with love and respect that we dedicate this series to Ignacy Waniewicz. In its enormous scope, its thorough documentation, its emphasis on concrete results, and its concern with educational issues, this series reflects both Ignacy's vision and his intellectual legacy.

Donna Sharon
for the Office of Development Research

Preface to the Series

NEW TECHNOLOGIES IN CANADIAN EDUCATION

These papers in the series "New Technologies in Canadian Education" are the result of an international commitment. In June 1980, the Third Conference of Ministers of Education of Member States of the European Region of UNESCO adopted a recommendation requesting the member states to carry out joint comparative studies on well-defined problems of common interest in education. At a subsequent meeting of the European Region National Commissions for UNESCO, 14 subjects were agreed on for joint studies.

The theme "New Technologies in Education" was selected as study #11. The 17 countries participating in the study are Austria, Belgium, Denmark, Finland, France, Hungary, Italy, the Netherlands, Poland, Spain, Sweden, Ukrainian SSR, USSR, United Kingdom, as well as Canada, Israel, and the U.S.A. who are also members of the UNESCO European Region. At the first meeting of the national coordinators from these countries, held in October, 1982, at the University of South Carolina in Columbia, South Carolina, U.S.A., a plan was adopted for the study. In the first phase of this plan, the individual countries are to report on the ways in which the new technologies are being used in education. (A brief outline of the international design is available on request.)

The Canadian Commission for UNESCO was requested to coordinate, on an international level, the first year of the study. We are grateful to the Canadian Commission for selecting TVOntario, and the Office of Development Research (ODR) to be in charge of this task. The ODR was also asked to coordinate the Canadian contribution to the study, with financial support from the Department of the Secretary of State. We gratefully acknowledge their assistance.

In preparing the Canadian review of the use of technology in education, the ODR contacted a number of educators, academics, government officials, administrators in educational communications organizations, and others, across the country. It became apparent that there was a strong need for a well-documented account of the uses of both the "older" technologies (e.g., film, audio, television) and the newer technologies (e.g., computers, videodiscs, videotex) in the complex Canadian educational system.

Early in 1983, several types of research activities began simultaneously: designing instruments to gather information from each type of institution or interest group, identifying uses and users of each type of technology, and exploring the areas where Canada's distinctive features predispose toward technological developments. The 17 papers listed on the back of the title page emerged as a result.

Information for these papers was provided by hundreds of individuals expressing their own views or reporting on behalf of educational institutions and organizations, government departments, public and private corporations. We extend to them our sincere thanks.

I would like to acknowledge the contribution made by Thelma Rosen who assisted in the development of the inquiry instruments and played a major role in the gathering of this information. The task of supervising the final editing, production, and distribution of the papers was assigned to Donna Sharon. Her resourcefulness and persistence have contributed greatly to the completion of this series. Sharon Parker typed most of the papers from the initial drafts to their final versions. Her dedication made it possible to complete the study in such a relatively short period.

While the preparation of these papers has been supported by the Canadian Commission for UNESCO and the Department of the Secretary of State, the papers' contents do not necessarily reflect the official views of either party on issues related to technology in education.

Ignacy Waniewicz
Study Coordinator
Director
Office of Development Research
TVOntario

January 1984

CONTENTS

Foreword . . . . . (i)

Preface . . . . . (ii)

Introduction 1

Universities in Canada 1
Funding 3
Scope of the paper 4

Use of film, television, video, radio, and audio 6

Use of film 6
Use of television and video 9
Use of radio and audio 13
Changes in teaching and learning 15

Use of new technologies 19

Computer technology for instruction 19
Computer technology for research 26
Computer technology in libraries 31
Networks and links among technologies 36

Computer networking and conferencing 37
Teleconferencing 39
Videotex/Telidon 44
Cable television 48
Communications satellites 50

Potential impact of new technologies 55

Curriculum 55
Liberal arts education 58
Higher education in general 60

Conclusion. 64

Notes 66

Appendix I. 69

Appendix II 72

Map of Canada 74

INTRODUCTION

Universities in Canada

In Canada, an institution of postsecondary education that has the power to grant degrees is called a university. However, several are called colleges, a few are institutes, and one is a school.[1]

The first universities in Canada were small classical colleges organized and funded by religious groups mainly for the training of clergy. After Confederation in 1867, education was made a responsibility of the provinces. While some universities continued to be established by churches or interested citizens, most universities, particularly after 1900, have been founded by provincial governments. Emphasis was placed on bachelor's degree programs in the arts, sciences, and humanities, and on the development of professional faculties such as law, medicine, theology, engineering, and veterinary sciences.

The major industrial growth that followed World War II created a need for skilled workers. Prevailing social values demanded universal access to postsecondary education, and there was pressure on the federal government to assist economic and cultural nation-building through education. For these reasons the federal government became involved in higher education on a large scale. It first undertook to finance the university education of returning war veterans by giving direct aid to students and operating grants to universities. From 1945 until the mid-1960s, despite the reservations of some provincial governments, the federal government gave financial support to universities directly through per capita payments. Many new universities were established during this period.

The full force of university expansion came in the 1960s as full-time university enrollment, undergraduate and graduate, rose from 128,630 in 1961 to 323,026 in 1971.[2] Graduate programs in nearly all universities were established. Between 1960 and 1973, the total of earned doctorates in Canada increased from 306 to 1,896.[3] In the 1970s growth of enrollments slowed. In 1982-83, full-time

undergraduate students enrolled in universities numbered 376,216; full-time graduate students numbered 50,173.[4]

During the 1960s and 1970s part-time enrollments also increased rapidly. In 1962 the total part-time undergraduate enrollment was 38,639, in 1975 158,294, and in 1982-83 233,051.[5] Part-time enrollments in graduate studies rose from 5,351 in 1962 to 26,731 in 1975, and declined in 1982-83 to 20,481.[6] Currently, growth is evident in enrollment in part-time undergraduate studies.

Extension programs for students who cannot attend on-campus classes are an accepted responsibility of universities. Manitoba has established regional resource centres to which universities and other types of educational institutions contribute. Quebec has successfully developed Télé-université as a branch of the Université du Québec. Athabasca University in Alberta and the Open Learning Institute in British Columbia are open universities which produce and deliver learning programs for adults who wish to study in their own communities or are unable to attend a traditional postsecondary institution.

Seventy-one degree-granting institutions in Canada are members of the Association of Universities and Colleges of Canada. Ontario has 28 degree-granting institutions, Nova Scotia 11, Quebec 7, British Columbia 5, Saskatchewan 5, Manitoba 5, Alberta 4, New Brunswick 4, and Prince Edward Island and Newfoundland one each.[7] Each controls its own admission standards and policies. Admission usually requires the completion of a secondary school program of study, but most universities admit mature students who have not completed the usual secondary school requirements following successful completion of a qualifying program.

The bachelor's degree is awarded after three or four years of full-time university study. Admission to law, medicine, theology, dentistry, business administration, and other professional faculties is usually conditional on completion of part or all of the requirements for a bachelor's degree.

There are several types of degree-granting institutions. Most universities have degree programs in arts and science. Larger institutions offer degrees up to the doctorate level in a variety of fields and disciplines. Some specialized

colleges offer degree programs in a single field, such as theology, engineering, art, or education. The Department of National Defence finances and operates several institutions primarily for the education of armed forces officers and persons in other defence agencies.

Most Canadian universities have four teaching ranks - lecturer, assistant professor, associate professor, and full professor. Salaries of university faculty vary from institution to institution, as do tuition fees. The federal government offers students a loan plan (except in Quebec where a plan is offered by the provincial government). Provinces offer qualifying students grants, scholarships, bursaries, and supplementary loans in cases of need.

Six universities use French as the language of instruction, six use both English and French. The other 59 are basically English-language institutions, but four of them provide opportunity for some or all of the courses for a degree be taken in French. Thus, university programs are available in English in all 10 provinces and in French, or largely in French, in all except British Columbia, Prince Edward Island, and Newfoundland.[8]

Funding

From 1945 until the mid-1960s, the federal government gave financial support through per capita payments to both the older and the newly established universities. All universities flourished, and graduate programs in nearly all disciplines were established.

In 1965 the federal government decided to make transfer payments directly to the provinces and agreed to underwrite one-half of all operating costs of postsecondary education incurred by the provinces. Since 1977, federal transfer payments have been combined in one global transfer that includes payments to hospitals, health insurance plans, and universities. The provinces add their contribution and distribute the funds within their jurisdictions.

Federal departments and agencies have continued to sponsor research projects at Canadian universities. Of the federal agencies that administer research funds, the most important are three councils that together cover all academic

disciplines: the Medical Research Council, the Natural Sciences and Engineering Research Council, and the Social Sciences and Humanities Research Council.

Over the past three years the federal government's economic restraint program allowed increases of six per cent and five per cent in transfer payments to the provinces. However, in some provinces the dollar transfers from the provincial government to the universities have not kept pace with the rate of increase in the federal transfers. The net effect is that at present a number of universities have less operating capital than in previous years. It should be noted that the transfer system is currently under review.

Scope of the paper

This paper reports information received from the presidents of 46 universities and their affiliated colleges across Canada. The initial information was collected through an extensive questionnaire which had been circulated to all member institutions of the Association of Universities and Colleges of Canada. (The questionnaire (see Appendix I) was prepared with the participation and cooperation of the Association of Universities and Colleges of Canada.) Presidents were asked to circulate the questionnaire widely throughout their universities. Questions were asked about universities' experiences with communications and information technologies, and about the use of computer technology as a research tool, in libraries, and for distance education. The universities were also asked to consider the influence of technologies on higher education curriculum, on the direction of liberal arts education, and on higher education in general. In June, 1984, a draft report prepared from this information was circulated to the presidents of all universities in Canada (and to government departments and other organizations of higher education in each of the provinces) requesting additional and current information about the use of technologies in universities. The list of universities that responded to the questionnaire and/or draft is in Appendix II.

The conceptual base on which the paper is structured is data-gathering through the questionnaire and subsequent reviews. This paper then is a report of the universities' activities in and views on technology in education and

reflects information gathered in a rapidly changing field. The quoted material that has been selected for inclusion is representative of the responses received, and reflects views expressed in all parts of the country.

The first section of the paper reports universities' use of the established technologies of film, television, videotape, radio, and audiotape. The second section reports uses of computer technologies for instruction, research, library services, and in computer networking and conferencing. Experiences with cable television, teleconferencing, and satellites are also described. The third section reports universities' comments on changes in higher education that might result from the introduction of new technologies. This organization follows the sequence of questions in the questionnaire.

USE OF FILM, TELEVISION, VIDEO, RADIO, AND AUDIO

Use of film

Film has been used widely in university classes for the past three decades. Two advantages that encouraged early film use were identified. First, it could be used either in group instruction or in individual self-study (University of Calgary). Second, it provided students with the opportunity, for example, to "experience a drama instead of simply reading a play" (St. Thomas More College of the University of Saskatchewan).

The ease with which film was incorporated into the educational process was also a factor in its early acceptance. Extensive faculty instruction was not required. While some instructors spent a considerable amount of time searching out appropriate films and their creative use, preparatory activities for many instructors often involved only booking equipment and learning to thread a projector. With the increasing use of film, on-campus film libraries and media centres were established in many universities. The Association of Universities and Colleges of Canada lists 29 universities across Canada with media centres.[9]

Some universities have been producers and distributors of university-level films. The University of Guelph writes that it "has been a major producer of university-level film and videotape especially in zoology, animal science, veterinary medicine, agriculture, and study skills." Productions have received international awards and have been sold widely to other universities, colleges, and schools in Canada and abroad.

Memorial University reports that its outstanding example of the use of 16mm film was in connection with the Extension Service's expansion of the University's public service function during the late 1960s: "In an atmosphere of widespread public confusion and uncertainty regarding resettlement and community development issues, film was used [in cooperation with the National Film Board of Canada] to promote communication among communities, groups, governmental and other institutions." This social animation technique was first used in a fishing community on Fogo Island and has

since become known as the Fogo Island Process. The Memorial Extension Service still uses the technique, with both film and video, as a development tool; and the National Film Board uses it with other Canadian communities as well. By showing films and videotapes made in and about a community, development workers direct the attention and discussions of local residents toward particular issues. This process is effective in finding solutions to community problems through consensus and social action.

Approximately half of the 46 universities reported the use of film to present supplementary material across a wide range of disciplines. Others reported more limited application of film on their campuses. Some mentioned a preference for face-to-face, teacher/student interaction with limited or no use of film. The following extracts give an indication of the range of use of film in the classroom:

> "Film is used fairly extensively by some professors in various areas, especially social sciences and Home Economics." (Brescia College of the University of Western Ontario)
>
> "In all manner of disciplines film is used to present data in an informative manner to students." (St. Thomas More College of the University of Saskatchewan)
>
> "The 8mm and 16mm will always be the media backbone of the campus." (University of Calgary)
>
> "Film has, of course, found its way into the courses of most disciplines though it is occasionally supplemented by videotape." (University of Western Ontario)
>
> "A Laval University survey indicates 50% of faculty have used/are using film." (Université Laval)
>
> "The use of 16mm film in classes has grown considerably, particularly since 1970. This medium appears to have maintained its profile even though video has come upon the scene in more recent times." (Saint Mary's University)
>
> "[We] support the use of film (and video) by operating an audio-video library in association with Library Services. To assist in its use, file cards describing the films are

filed in the indexes of the library's written documents. This permits a multi-media approach to the use of teaching materials. Individual screening rooms are installed in the departmental libraries of humanities, social sciences, health, etc., to allow teachers and students to screen these materials at their convenience." (Université de Montréal)

"Most faculty members regard the direct contact between students and faculty members as being crucial to university teaching. The essence of that teaching is guiding students in pursuing their own individual studies. A relatively small proportion of our teaching is routine instruction in techniques and this limits the use that can be made of new technologies. To some extent, film, video, etc., can be useful as a supplement to the main teaching program." (University of Toronto)

"We have made limited use of movies, tapes, film strips...to complement class lectures. We are still largely dependent on lectures and the University library as vehicles of instruction." (Saint Francis Xavier University)

"I show few films or videos because I believe they are a poor substitute for teaching or for books. In some disciplines, e.g., archaeology, they can be 'enriching' but in history they are too often simplistic or propagandistic. And it is so much easier to show a film than to teach that one may be tempted to sit back and let the film roll." (Brandon University)

Several universities expressed a demand for new films. York University, for example, states:

"The film librarian has found that there is a demand for new content in films. It has been her experience that these demands reflect changes in societal concerns. For example, she is now receiving requests for information on the impact of computers in the workplace in all its ramifications."

While some institutions are looking for new films, some institutions are in the process of phasing out film and committing themselves to videotape. The University of Calgary reports: "Videotapes and videocassettes were and are

used as a flexible alternative to film." York University offers the following comment:

> "It is the impression of the film librarian that faculty see video and film as interchangeable. They are aware of the different physical properties of the media and like to use video because of its ease of handling and flexibility. But they see no differences in their aesthetic properties and consequently, in the impact on the viewer."

Some institutions, such as York University and Simon Fraser University, use film and videotape as the situation dictates, and have sizable collections of material in both formats.

York University's Department of Film in the Faculty of Fine Arts, which concentrates on film production, has just received university senate approval to change its name to the "Department of Film and Video."

Use of television and video

Most universities use the terms "television" and "video" interchangeably as meaning televised images appearing on a monitor or television set, regardless of the technology by which they are communicated. In this paper the writer uses 'television' to mean broadcast and/or closed-circuit television, and 'video' to mean television on videocassette.

The French-speaking universities were the first to undertake serious work in educational television in the early 1960s.[10] Aided by the French language network of the Canadian Broadcasting Corporation (CBC), they broadcast television courses for undergraduate credit on a television network from St. Boniface, Manitoba, to Moncton, New Brunswick.

In English-speaking Canada, universities initially looked to the CBC to undertake similar broadcasting of televised courses,[11] but this proved unfeasible for jurisdictional and constitutional reasons. In the 1960s, the University of British Columbia, Queen's, and other universities, broadcast continuing-education television courses in arrangements with private television stations. Cable television and satellites

are now the major means of televised distribution of university courses. They will be discussed in the third section of this paper.

Rapidly rising university enrollments in the mid-1960s resulted in a number of institutions - among them, the University of Manitoba, Carleton University, Memorial University, McGill University, Queen's University, the University of Toronto, and Concordia University - using closed-circuit television to transmit lectures to locations within the campus. When Scarborough College of the University of Toronto opened in 1965, major use of television for instruction was planned. The story of Scarborough as a "television college" is described by Lee.[12] Lectures were to be prepared in advance, recorded on videotape, and replayed during the academic year in theatres seating 200 students. The taped lectures could be reused for three years. Fewer instructors would be needed. Science demonstrations could be shown to small groups in laboratories throughout the university, thus giving all students a clear view of procedures. Elaborate television studios were constructed and television was "built into the very fabric, both physical and educational, of the college."[13]

Shortly after the College opened, it became obvious that things were not happening according to plan. Most faculty were not able to master television teaching, and a number were reluctant to undertake the training required. Concerns arose among faculty regarding ownership of lecture material and copyright. Instructors' relations with the production staff were uneasy. Students found that long videotaped lectures exceeded their attention span. Enrollments did not rise as expected. By 1970, the college was reverting to traditional classroom lectures.

Today the videotaped lectures have been abandoned and the production equipment has been sold. In Lee's opinion, the potential of television in education was never understood and was never creatively approached as a means of teaching and learning.[14]

Although universities continue to use live closed-circuit television for demonstrations, videotape cassettes or "videocassettes" containing pre-recorded television are in wide use. Videocassettes are compact, easy to use, and adapt well to both in-class presentations and self-instruction in

media centres and libraries. Lightweight portable cameras are available and can be used to record material directly on videocassette by students or faculty for immediate or later reviewing. Large screen projection has improved greatly, permitting clearer presentation and magnification of images when shown in lecture halls. Cassettes are easily stored and shipped. The standardization of recording and playback equipment has allowed for interuniversity exchange.

The following quotations indicate the wide range of applications of television and video in universities:

> "Botany uses a specially prepared series of videotapes for the laboratory session in Plant Biology... English and Extension Education make regular use of videotape for observation and feedback of student performance in public speaking and teaching assignments...Veterinary Medicine and Land Resource Science, for example, use video recordings for feedback in improving seminar performance...Family Studies and Child Studies classes use low cost, half-inch, portable videotape recording equipment for student assignments...Human Kinetics uses film and videotape extensively in analysing human movement...the Clinical Studies Department uses video and film recorded operating techniques to reduce the use of live animals in demonstrating procedures which cause pain and death. This application of videotape to reduce the use of live animals for teaching demonstrations has ethical and economic considerations which make it one of the more significant uses of videotape...Sociology uses video recorded television commercials for in-class critique and analysis of social phenomena." (University of Guelph)

> "Videocassette recorders and monitors are readily available from a central audiovisual service and are used regularly throughout the University in virtually every discipline." (University of Victoria)

> "Video is used for the recording of lectures individually and in series, for instructors unable to attend in person...and for deposit of learning materials in video format in libraries and audiovisual centres." (Concordia University)

"Videocassette use has changed the overall nature and application of television, transforming it from the mass communications medium of broadcast television to a selective communications medium, and from a delivery system for entire courses to a delivery system for simple concepts." (University of Manitoba)

"For twelve years the Université de Montréal has made production facilities available to teachers and students in each main campus. They can acquire cameras and recording equipment to assist them in preparing their assignments or lectures." (Université de Montréal)

"Owing to the relative ease of doing so, there has been more production of videotape materials on campus than there was of film and a few courses, notably journalism...involve students in the production process." (University of Western Ontario)

"Video is now viewed by faculty as a tool such as writing. They are, therefore, learning about direction and how to produce their own segments for instructional use." (Mount Saint Vincent University)

"Because we are an art college, one of the effects of technology on our curriculum occurred in the late 1960s when artists began to use video as an art medium. Consequently, an audiovisual centre with an emphasis on video was established in the early 1970s which catered to the use of sound and video as artmaking tools. This centre includes a video studio, a sound studio, two VTR editing rooms and four portable video units." (Nova Scotia College of Art and Design)

A number of universities indicate they would like new program content for video. The University of Windsor writes, "the demand for new program content for both film and videotape is endless. Available resources will not satisfy the academic needs." The University of Lethbridge comments that there is a vast lack of Canadian content, particularly in the social sciences.

The University of Toronto indicates a demand for new programs, "but the vast majority of instructors wish to have a hand in its development. Often instructors are not content to use pre-packaged materials."

The University of Victoria makes the following statement regarding quality:

> "The establishment of the Provincial Educational Media Centre (PEMC) in British Columbia has had a profound effect on film use and film production in the province. The decision by PEMC to use video exclusively has made film production uneconomic for producers and the quality of local program materials has suffered considerably. This effect was not foreseen in the decision to move to video from film."

Memorial University says that new content is continually sought as a matter of course. "Even if particular information does not become dated, the context in which it is employed constantly changes. Even though a presentation may be excellent its creators are mobile and an urge is always present to remake and revise."

Use of radio and audio

The most well-developed use of radio broadcasts for university education has been by Open College/Ryerson. The Open College and Toronto radio station CJRT-FM cooperate to offer broadcast radio courses given by faculty of Ryerson Polytechnical Institute for academic credit and community education. The project is known as Open College/Ryerson and is geared primarily to mature students. Course lectures are supplemented by textbooks, student workbooks, and tutoring by telephone and face-to-face contact. Academic credit is granted through Ryerson. Atkinson College of York University also grants credits to Open College students for successful completion of radio courses. Open College lectures are available on audiocassette.

The University of Manitoba mentions that it has broadcast on rural radio stations "to extend the presence of our University throughout the province." L'Université du Québec à Trois Rivières refers to ongoing experiments with radio instruction. The University of Prince Edward Island has used radio broadcasts as part of its distance education courses. Athabasca University also uses radio broadcasts (in cooperation with ACCESS Alberta's radio network) as components in its distance education courses. The University of Victoria reports that it uses radio to broadcast public-

interest and public-relations material, and that student associations use FM stations to serve the university community.

The medium of audiotape, particularly when packaged as an inexpensive compact audiocassette cartridge, is in wide use in universities. Simon Fraser University summarizes one major use of audiotape:

> "A recent development to assist students who have missed lectures or who wish to review lecture material is the taping of about 50 first and second year introductory lecture courses per week. These tapes are available via a resource system administered by the library."

A second major use of audiocassettes is in language instruction in audio labs. This use was mentioned by many universities.

The University of Manitoba provides this example of yet another use:

> "The combination of audio and 35mm slides usually synchronized is being used in courses, in displays used by the Admissions Office, and in other applications. This medium, unlike television or film, is particularly insensitive to the size of audience."

The Université de Montréal reports:

> "Audiocassette recorders are considered as common a working tool for teachers and students as a typewriter or pocket calculator. For this reason they have been removed from the lending service and the funds thus freed have been used to update film and sound editing equipment available to teachers and students."

Many universities involved in distance education make extensive use of audiocassettes as one of several learning methods. Athabasca University, the University of Waterloo, the Open Learning Institute of British Columbia, Open College/Ryerson, and Télé-université of the Université du Québec, are among this group. The successful utilization of audiocassettes in its correspondence programs allows the University of Waterloo to "replicate the classroom course and send it all over Canada with great effectiveness, economy,

and success." The Correspondence Program at the University of Waterloo offers more than 280 degree-credit university courses in many disciplines. One of five students at the University of Waterloo is enrolled through its Correspondence Program. Each student receives a complete learning package comprising lectures on audiotape cassettes together with accompanying notes, diagrams, charts and other print material. Short tutorial audiotapes are usually sent to the students reacting to their assignments and assisting them with any difficulties.

Changes in teaching and learning

Most universities indicate that there have been some tangible changes as a result of their using audiovisual technologies. For students, the use of film, videotape, and audiotape makes available additional learning activities and opportunities. For faculty, the technologies are a supplementary or an alternative means of providing information to the students.

The University of Western Ontario writes: "It is not clear that much instructional innovation has been caused by technological innovation but technology has been conscripted to serve instructional goals."

The University of Saskatchewan reports:

> "Tangible changes have been noted in most areas where television has been used; but notably in the sciences, where it has become a primary teaching mode in certain classes. First year Anatomy, for example, and Mechanical Drafting are taught almost entirely through the use of (closed-circuit) TV systems. In these and many other areas, live lectures, heavily illustrated with television demonstrations and enlargements of microscope slides have replaced the single-student, single-instrument techniques of former lectures."

The University of Manitoba reports that many of its professors are making their own videotapes, thus creating learning materials that are directly applicable to their courses and that make a stronger impact on their students. Concordia comments on changes in note-taking by students, who can now replay a tape of the lecture. Handicapped students

have benefitted by having tapes available for review. Memorial University reports: "Students in many cases organize their own learning situations when the authority of the teacher is absent from the classroom setting." The University of Calgary sometimes assigns television programs or films for viewing in the same way that readings have traditionally been assigned. Some universities report that videotape allows students to engage in self-evaluation, to analyze their own performance as well as to study sample interpersonal encounters. This is of great use in the counselling courses. The stop and slow-motion capability of videotape and film also makes possible the detailed observation of human movement, a function useful in physical and health education and for athletics. The University of Victoria says that the steadily improving cost/performance ratio of video equipment and a growing supply of useful video programs are other factors contributing to its increasing use of video.

Perhaps the most significant change in teaching and learning has been the growth of distance education utilizing television, videotape and audiotape combined with newer distribution technologies such as satellite, cable television, audio and video teleconferencing, and videotex.

A number of universities have arrangements for broadcast and cassette distribution of their own internally produced television programs (or those acquired from other educational institutions) with provincial educational communications organizations and cable companies. (Paper 7 in this series deals with the provincial educational communications organizations in Canada.)

Almost without exception, responses from universities indicate that audiovisual technologies could be used even more effectively than they are at present. There is general recognition that the need for faculty training is ongoing and that, as the University of Toronto puts it, "the initiative in making changes in teaching methods lies with individuals or groups of faculty members. The University facilitates such changes by providing technical, consulting and production facilities."

A number of universities have training programs for faculty. For example, York University's Educational Development Office and the Department of Instructional Aid

Resources offer a series of workshops to faculty on how to use media creatively in teaching. McGill University has developed and tested innovative teaching and learning methods - for example, modular courses employing audiovisual support, a teaching improvement process using videotape, for the presentation of subject matter.

At the University of Victoria, faculty members videotape their classes and analyze the tapes in order to improve their teaching. At the University of Guelph, faculty members taking part in lecturing-skills workshops receive video feedback on their teaching styles.

There is an awareness among some universities that there is still much to be understood about the effects of audiovisual media on the learning process. Université Laval speaks of the importance of taking into account "the rhythm of learning" when producing audio and videocassettes. The need to produce learning materials for distance students helped universities recognize that media-based learning materials (video, audio, and print) require special organization in presentation and that faculty members need training in course design. Memorial University says that course content should determine the medium or media used to present it most appropriately. Ryerson Polytechnical Institute supports this view: "Visual media should only be used for material that needs to be visualized, e.g., cell theory, botany, art. It is inappropriate for abstract content, courses on literature, philosophy, history."

The complexities surrounding the use of videotaped lectures, especially on a large scale, have not been lost on the universities. Brandon University states:

> "We have no doubt that TV/videotape can be a useful teaching tool but it should not degenerate into teaching by proxy! There is a risk, too, that courses may become more stereotyped because of the time and expense required to alter or adjust them. Ideally each programme should be revised annually which might reduce the cost-effectiveness of this system."

McGill University makes a summary statement:

> "The degree of use depends upon the individual professor, the departments, the nature of the course and the student

population. These considerations in addition to the university's policies of encouragement, necessary funding, available equipment and human resources determine the extent of media use at a particular university."

USE OF NEW TECHNOLOGIES

Computer technology for instruction

The mainframe computer has been used in universities for over 25 years as a tool in research, scientific computation, and administration. Each university, according to its size and focus, has followed a different path in computer use. The advent of the minicomputer and the microcomputer has made even wider use of computers possible. This section deals with some of the experiences and developments in the use of computers in instruction as reported by the universities.

In this paper, the term computer-based learning (CBL) includes a variety of computer functions used to support classroom instruction, including traditional uses for computation in math and sciences, compiling and analyzing data in the sciences and humanities, word-processing, in creation of graphics for various engineering and other design courses, and simulations in math and physics. Computer-assisted instruction (CAI) is defined as learner interaction with the computer to work through sequences of instruction and specific exercises relating to the curriculum. Computer-managed learning (CML) uses the computer to keep student records, score tests, interpret results, monitor student activities, and administer course materials. Using specially designed software, CML can generate learning and testing materials, thus providing learners with data for self-assessment and evaluation of their learning.

At present, computer-based learning is being used in universities in a wide range of disciplines.

> "The number of courses using computer resources has been increasing by close to 25 per cent each year for the past three or four years. While no course is entirely computer-based, the technology is seen as a useful instructional supplement mainly for assignments and compilation and analysis of data...Computers are being used by every faculty on campus. The major stumbling block to increasing the use of computers is the purchase of hardware adequate to the demand. At present the major emphasis is on managing current demands rather than in creating new ones." (Carleton University)

"Principal fields of computer application are as follows: a developmental project in computer-assisted design; scientific computation in chemistry, physics, geology, biochemistry, biological sciences and mathematics; compilation of dictionaries for linguistics and translation; processing of historical documents; sound synthesizing for music; development of instrumentation and measurement in optometry; diagnosis in veterinary medicine; analysis and evaluation of performance in physical education; calculation of nutritional balance in dietetics and nutrition; teaching of biomechanical principles; prosthesis design and statistical calculations in rehabilitation, among others." (Université de Montréal)

"Computers are recognized and applied in chemistry, communications, earth sciences, literacy sciences, accounting sciences, and others...Two limitations exist, available resources and lack of faculty trained in the technologies." (Université du Québec à Montréal)

"Computer-based learning has been used in several disciplines and at various levels for several years. Current CBL efforts include courses in math, biology, and medicine. Also, many courses are using statistical analysis systems such as SPSS; graphics facilities are being used in a cartography course; structural analysis and project management systems are being used by engineering students, text formatting facilities are used for production of theses." (Memorial University of Newfoundland)

"With the introduction of producing graphics on the Macintosh and other computers there will be a trend toward instructors producing their own graphics in almost all disciplines. In fact, the University of Saskatchewan is establishing centres on campus where graphics can be produced on the mainframe computer by an instructor at his/her own terminal." (University of Saskatchewan)

"There is a high degree of recognition and acceptance of the potential of computer-based learning and instructional services and a high degree of actual implementation...Computers are widely used in many courses besides those in computer science as more and more programs insist on computer literacy and as more and

more students in many disciplines insist on becoming computer literate." (University of Waterloo)

Many other universities report growing uses of computer-based learning, including Simon Fraser University, the University of Victoria, the University of Calgary, the University of Regina, the University of Winnipeg, Saint Mary's University, Queen's University, the University of Western Ontario, and the University of Guelph.

Lakehead University says that the computer is now viewed as an aid rather than a threat: "Many departments recognize that computers will become an essential tool for their students after graduation. They try to give experience in simulations, statistical analysis, project numerical analysis, case studies, and thesis preparation."

Athabasca University depends heavily on the use of computing technology, including the use of remote terminals in its regional offices for student registration. There is heavy use in institutional research and analysis (particularly vital to the distance learning operation), and a steadily increasing utilization of microcomputers in course development and course delivery. Brandon University reports that computer technology is used in music education, where it has applications not only in teaching but also in composition and in research. The University of Alberta reports using computer-based learning extensively in its Faculty of Medicine. For example, the computer portion of the second year cardiology course comprises almost 30 per cent of the course.

Computer-assisted instruction in universities has been hampered by a lack of high-quality courseware, by a lack of money for purchase or housing of computer equipment, and by a lack of faculty expertise and interest. Considerable skepticism exists in some universities as to the real benefits of CAI.

"There is considerable debate on the question of the potential of computer-assisted instruction for university level work. There is at present relatively limited use of computers outside the computer resources department for instructional purposes. Only a limited number of staff have any knowledge of the computer-assisted instructional methods and, given the present funding

situation, few are likely to develop such knowledge or have any prospect of putting it to use. Without considerable extra funding the University lacks the resources to provide staff with the necessary training or to develop course materials or purchase extra equipment." (University of Toronto)

Simon Fraser University comments that there is resistance to computer-based education in situations where a computer and software might make an instructor unnecessary. Brandon University says there is a need for a clearer definition of the role of CAI: "Perhaps CAI is most applicable to the 'drill' of basic facts, and for a knowledge retrieval system for answering a student's questions as to how? why? what? who? Classroom instruction can then be used to bring concepts together into a broader perspective." Mount Saint Vincent points to the need to differentiate between which instructional materials should be computerized and what should not, and to consider the support service and staff required to maintain the hardware.

One of the largest applications of computer-assisted instruction in universities is found at the University of Alberta. The Programmed Logic for Automated Teaching Operations (PLATO) system is being used to develop and deliver teaching materials in over 30 courses enrolling hundreds of students. The system is used for an average of 10,000 student contact hours per month. The Faculty of Extension also maintains a PLATO Learning Centre, which delivers a variety of courses to adults in the community. An authoring system (OMNISIM) has been developed at the university that allows for easy creation of PLATO software. The University of Calgary has entered into a joint agreement with the University of Alberta to use the PLATO system by means of a data linkage to Edmonton through the computer services units on the respective campuses. The University of Alberta's PLATO system is also linked through telecommunications to other PLATO systems around the world, permitting communication via electronic mail. Another user of PLATO is the Université du Québec, which uses the system at its various campuses and for some Télé-université distance education programs. Each of the Université du Québec's campuses (Ste-Foy, Hull, Chicoutimi, Montréal, Rimouski, and Trois-Rivières) have PLATO terminals and Télé-université has additional terminals which are moved from city to city as

needed. The University is translating existing courseware into French, and new PLATO lessons are also being developed.

In a recent study, the Faculty of Arts and Sciences at Queen's University[15] recognizing the potential for CAI as a time-saving device for faculty, recommends that the University provide opportunities for increased research into CAI and faculty training in computer and other information technologies. This is a partial response to a need to prepare the University to accommodate changes in skills and expectations among new students who acquired computer literacy and proficiency in elementary and secondary schools.

A McGill University report on instructional computing states: "While large-scale CAI on the mainframe has held at respectable levels it is anticipated that greater growth will occur in the area of micros for CAI in the future."[16] At the Université du Québec à Montréal, all students and faculty have access to microcomputers. Queen's University will be "strongly encouraging" students entering the first-year engineering program in 1985 to buy their own microcomputers. The model will be recommended by the Faculty of Applied Science. Purchase of a micro and software is expected to cost each student $2,000; the University plans to offer loans and discounts to students. Micros will be available on the campus for students who cannot purchase their own.[17]

The Université du Québec à Trois Rivières makes the following statement concerning the use of computers for instruction:

> "There are three main urgent responsibilities: (1) to encourage experience in the use of new technologies in education to know better their potential; (2) to train teachers to use the technologies in instruction; (3) there is a huge problem regarding lack of software that only well-organized interuniversity collaboration would be able to solve."

Some universities are addressing the problem of software. For example, the University of Victoria is initiating a major research project into the principles and strategies of developing courseware of high quality, and the Université du Québec is interested in standardizing and exchanging courseware among its various campuses and with other Canadian universities.

The University of Calgary is currently working with Control Data Corporation in a two-year study to use and evaluate the courseware available on the PLATO system. The University is working with the Honeywell Company Information Systems Group to prepare courseware using the National Research Council's NATAL authoring language. It is hoped that these projects will lead to a major development and distribution centre at the University of Calgary for computer-based instructional materials. Although these two projects use mainframe computers, Calgary is also exploring CAI using microcomputers, and expects to secure research contributions from other educational institutions and independent educational software companies.

The need to increase faculty computer literacy is recognized. For example, Memorial University of Newfoundland offers seminars and workshops on computer-based facilities. At the University of Waterloo, the Department of Human Kinetics and Leisure Studies and the Department of Computer Services offer short courses to faculty and staff on subjects ranging from text processing to spreadsheet and database use to programming. The University of Winnipeg states that if it were to work jointly with computer companies, pilot projects could be developed to train faculty members in the use of the computer as a teaching tool and, ultimately, to develop appropriate courseware. Other universities also report the need to train faculty and, as faculty become trained, to purchase hardware and software to meet their demands. The University of Windsor reports a need for training programs in developing applications in computer-assisted design and computer-assisted manufacturing (CAD/CAM) and Telidon.

The University of Waterloo says: "Faculty training would need to stress knowledge of learning principles and course design at least as much as programming skills: much existing CAI is pedagogically quite naive."

L'Université de Montréal reports that it has recently created a Coordinating Centre for Campus Computer Services to deal with increasing demands from departments for access to computers, to ensure overall coordination, to develop computer-assisted teaching programs, and to train faculty.

Other universities indicate that uncoordinated planning and policy strategies within and among universities, lack of

evaluation studies, and copyright problems are other factors slowing development and use of CAI.

Those universities that hope to receive funds from large corporations might be in a position to increase computer use and applications. Mention has already been made of cooperation between the University of Calgary and Control Data Corporation. Other cooperative projects are being established. For example, the University of Waterloo's Institute for Computer Research has received large computers, personal computers, and work stations from Digital Equipment of Canada for research in CAI, CAD/CAM, computer graphics, videotex, very large-scale integration (VLSI), microchips, artificial intelligence applications, office automation, software engineering, and networking. Systems developed at the Institute will be offered to other educational and industrial groups.

The Ottawa-Carleton Research Institute which includes the University of Ottawa, Carleton University, and Algonquin Community College, is supported by technology companies in the Ottawa region and by federal funding to conduct research and develop computer software. The agreement between the Province of Alberta and Control Data Canada will allow the University of Calgary to acquire a "supercomputer" (a Cyber 205) in the Fall of 1984. The computer is capable of simulating complex conditions for the oil, automobile, and aircraft industries, and will also be used in medical research and applications. The University hopes its faculty and visiting scientists will work on fifth generation computing applications and research. The computer will be made available to faculty and students at other Alberta institutions.

York University and IBM Canada have entered into a cooperative agreement to create a teacher microcomputer resource centre in York's Faculty of Education. Part of the centre's function will be to provide guidelines on the testing, evaluation, and use of microcomputer software in the teaching/learning process.

The Computer Systems Research Institute at the University of Toronto has been established to do research and development in the design, implementation, and operating characteristics of complex computing systems and to see that the results of these investigations are used to improve

information processing in universities, government, and business.

Computer-managed learning is used as an administrative tool by a number of universities, particularly in record-keeping. Its potential to generate self-assessment and self-evaluation materials for students has not yet been realized. The University of Calgary is doing work in this area, and the Université de Montréal uses CML to adapt a correspondence course in written French to each student's needs, to correct tests, and send to each student confidential test results.

Computer technology for research

R.E. George summarizes the history of research computing at universities as follows:

> "Early efforts at universities in the late 1950s and early 1960s were directed toward having a small computer available in one or more laboratories to process scientific data. In Canada, the only university with a major computer facility then was the University of Toronto. During the early 1960s, many universities purchased general computers from IBM and began to move from purely scientific use to a mixture of administrative and scientific uses...Other than the development of dependable FORTRAN compilers and products like WATFOR developed by the University of Waterloo, most students did not have easily accessible computing, and with long turnaround times faculty members tended to avoid computers...very few tools [were] concerned with the productivity of professional researchers...the situation today is such that researchers are clamoring for access to microcomputers and minicomputers which they perceive as the only way to meet their short-range research objectives even though appropriate software is not generally available for their use."[18]

George adds that some microcomputers may be unable to provide the text processing, graphics, database management, and software-development tools that would make them more productive. Long-range planning for the correct mix of computers for research purposes is required, as is planning for access to a mix of computers through networking. The demands placed on the computers and the establishment of

training for technical support and other personnel must be assigned priorities.

The desirable facility for a researcher, says George, is a software-rich computing environment with high-speed and high-resolution graphics, a large file storage space, a user-friendly editor and user interface, a high-speed communications network between users, and large high-speed computational devices. The key to such a facility is the degree to which software can be made compatible, files transmitted, and text editing accomplished locally and remotely and shared with colleagues anywhere on the globe. The need, as George sees it, is for "supercomputers" that are capable of providing high-level modelling, simulations, and numerical analysis required to solve current research problems.[19]

As is the case with software development, it appears that the universities that can find funds and resources beyond those provided by provincial governments have a better chance of conducting important research. The University of Toronto notes that 10 per cent of the time of the Cray supercomputer recently acquired by the federal government will be made available to universities, and adds, "It is not easy to see how convenient this will be or if it will meet the needs."

The University of Calgary says that computing options for research extend from the use of microcomputers for laboratory experiments to the use of central mainframes for complex data analysis and storage. Central and department-based facilities exist on campus for computerized storage and distribution of text resources and scientific data. The University of Western Ontario says that the computer is being increasingly used in the research activities of the arts and humanities because of text-processing capabilities.

Queen's University states that in the year 1982-83, 415 members of faculty used $1.2 million worth of computing services for research and 618 graduate students used $450,000 worth of services in connection with research projects. These dollar figures are artificially low, Queen's comments, when compared with the cost of the same services purchased commercially. At Queen's, the computer performs information-handling tasks ranging from numeric computation in science to symbolic computing for artificial intelligence.

Queen's states that proper support for research at its university requires: an adequate general-purpose computing system which is readily accessible, easy to use, and which provides satisfactory response time to users at all levels of sophistication; advice and coordinating information for those who require special-purpose computers, such as real-time laboratory facilities or graphics work stations; access to a satisfactory range of programming languages, program libraries, and discipline-specific program packages; advice and assistance, at a technical level, sufficient to encourage efficient use of the computing system.[20]

The University of Victoria says that virtually every department in the University is using computers in data acquisition, data processing, word processing, database management, and other research-oriented applications. McGill University comments that extensive use of computers for research has necessitated the offering of advanced research design and statistics courses.

The Ontario Institute for Studies in Education indicates that it uses computers for experiment control, word processing, statistical analysis, data archiving, bibliographic search and information retrieval, and research related to computer-assisted instruction.

At Memorial University computers are used in laboratories to control, monitor, and process the results obtained from experimental equipment. They are also used in the natural sciences, medicine, and engineering for similar purposes. As data analysis tools, computers are used in all disciplines, including linguistics, economics, philosophy, and education. They are used for modelling in many fields, such as economics and engineering, and for database maintenance and searches in medicine and history. The use of graphics is increasing as researchers monitor and display projects on such topics as iceberg drift and population density.

York University says its Faculty of Environmental Studies is advancing rapidly in the use of computers for research and uses databases routinely. In this Faculty, all microcomputer hardware and software used for research has been purchased by individuals, sometimes with the aid of a research grant. A large number of microcomputers serve as intelligent terminals in conjunction with the mainframe host; this allows for

better and more convenient local computer service and rations the use of computer time on the mainframe more efficiently.

The University of Toronto indicates there is a strong trend toward departmental rather than central computers. There are approximately 10 VAX machines used for teaching and research that are run by individual departments such as physics, chemistry, electrical engineering, and computer science. The University of Toronto and the University of Waterloo have established a Cooperative on Information Technology which also includes as subscribers government agencies, crown corporations, and private companies in business and industry. The purpose of the Cooperative is to serve as a catalyst and a support mechanism for research and study in information technology and its relationship to society. The Cooperative facilitates research projects; acts as a clearinghouse for information on multidisciplinary projects; issues a periodic newsletter and sponsors meetings and workshops; furthers the teaching programs of both institutions by providing support for existing courses and by encouraging the development of new multidisciplinary courses; sponsors events to increase interest in, and support for, multi-disciplinary research and teaching; works with government and industry in focussing resources available in the two universities on critical problems in information technology.

At the University of Waterloo, the Institute for Computer Research helps researchers in the University, industry, and government to work cooperatively. Waterloo's work/study program allows students to gain experience on outside computer systems by working in industry as part of their education and to apply their experience in various research activities on campus. Contractual agreements between Waterloo and such companies as IBM, Digital Equipment of Canada, Hewlett Packard, and Oxford University Press, among others, contribute directly to the growth of computer research. The University of Waterloo is one of several universities testing computer software developed at the University of British Columbia to promote computer networking for researchers.

The Université de Montréal reports:

"The recent recommendation of the Council of Universities of Quebec (Conseil des Universités du Québec) advocating

> the creation of the Montreal Computer Research Centre (Centre de recherche en informatique de Montréal) is the result of intense cooperative efforts among several universities in which l'Université de Montréal played a decisive role. As an advanced university training centre, the Centre took as its mandate to identify, promote and undertake high-technology projects aimed at developing computerized products and services, and to train a highly qualified staff, mostly at the doctorate level. The objectives of the Centre are to establish, in collaboration with industry, government, and universities, the frontiers which ought to be explored, to undertake the training of research teams, to develop close relations with the private sector in Quebec, to expand computer hardware and research facilities, as well as the number of computer researchers, and to encourage communication among researchers, teachers, students, and trainees."

Although most of the larger universities are using computers as research tools, a number of smaller universities indicate that they lack the funding to do the same. Lakehead University, for example, comments: "Researchers can only understand the potential of computers when facilities can be seen. There is presently no seed money for new services to be shown. Cooperation and support from larger universities in joint projects would help. Although there is good cooperation between computer centres, there is not the same support at the research level."

Brandon University says that until recently it has had little technical support for the maintenance and repair of complex electronic equipment, and that it lacked the resources to provide back-up equipment when something went wrong. It has sometimes been necessary to send equipment to a larger centre for repair, increasing costs and losing time. Brandon suggests that small universities can probably exploit their limited computer resources most wisely either by using computers as an aid to specific research projects or by developing comparatively simple technologies for local needs - for example, developing search capacities and cataloguing techniques for smaller libraries.

Several universities mention computer access to established bibliographic databases elsewhere on the continent as enhancing potential for research. Most

universities have access to numerous databases, for example, ERIC (Educational Resources Information Centre), a database of the United States National Institute of Education, MEDLINE, a database of the United States National Library of Medicine, and COMPENDEX, a database of international engineering and technological literature.

The need to assess the implications of computers for university research is also cited. Queen's suggests that questions such as how electronic information affects patterns and styles of learning should be examined. New principles in organizing ways to manage, process, and integrate, electronic data could also be developed. Brandon University wrote, "As more people use the new technologies involving communication by the TV screen or the computer terminal, they must become accustomed to the restricted visual reference points contained in a rectangular screen. If much of our learning is to take place using this format, what effect will it have on our sense of composition, design, texture, and shape?"

In order to deal with ongoing decision-making regarding computer-related issues such as access, distribution, and faculty training, and on other issues such as cooperative projects with industry and government, a number of universities have established computer councils or committees. Awareness of the need to make the most efficient use of their computer resources is expressed by many universities.

Computer technology in libraries

Computer technology has resulted in a number of changes in the organization and services of many university libraries. Carleton University makes the generally applicable statement that the introduction of computerization has led to enhanced access by users and more efficient use of staff. The University of Victoria states that its library "has introduced technological advancements with positive acceptance and beneficial results." However, some universities report a certain reluctance on the part of library staff and users, including faculty, to learn new techniques. Most universities expect increased computerization of libraries over the next five years. Simon Fraser University foresees that some journals will only be available electronically in the future, and adds:

"Given computer networking and electronic search and file, one 'central library' file can serve many institutions, eliminating costly duplications of letter press material and the high costs of cartage. Will people use microfilm and electronic files? [We] believe they will with appropriate orientation and realization of the power of the systems for scholarly work."

The newer library technologies are being used in several areas:

- Computerized cataloguing of library materials. Many universities have access to and contribute to a network of bibliographic records through UTLAS (University of Toronto Library Automation Service), an online database service developed at the University of Toronto. Computerized cataloguing also maintains intra-university bibliographic files. Other computerized library systems such as GEAC and the University of New Brunswick's PHOENIX system have capacities similar to UTLAS, i.e., the capacity to handle circulation, serial control, acquisition and cataloguing and to be networked.

- Automated acquisition of library materials through book dealers linked to the online network. This system may include electronic mail capability. Ordering, fund accounting, and maintenance of on-order and vendor files are all carried out by computer.

- Computerized control of circulation of library materials, maintenance of online user files, and interlibrary loan handling. UTLAS, for example, links some 275 libraries using networks such as Datapak, Dataroute, and Tymnet.

- Online searching and information retrieval from various databases outside the library, such as ORBIT and DIALOG.

- Online public access to a catalogue of university holdings.

The University of Waterloo Library uses an advanced GEAC library system for most of its activities, including the management of circulation, data entry, and materials acquisition. The WATMARS system (Machine Assisted Reference Service) provides simple access to over 300 bibliographic databases, and the Community Access Module provides online

access to Waterloo's holdings by universities, private companies, and others. The implementation of an online catalogue system to meet Waterloo's specifications is expected by 1986, and experiments in interlibrary loan systems and computer-based instruction on use of the library are also underway.

The library at the University of Guelph has been computerized for the past 15 years. Online services for literature retrieval, public inquiry, and circulation records are currently operational, and, beginning in September 1984, the library's catalogues will be online. The 30 user terminals in the library are part of the larger on-campus computer network, and can access up to 500 databases.

In Quebec, the Library Subcommittee of the Conference of Rectors and Principals of Quebec Universities has played a leading role in the automation of university libraries, and particularly in the automation of cataloguing services. The university libraries are also cooperating in studying the effects of using the new technologies in services offered to the public (electronic mail, online document-ordering services, videodiscs, videotex, and microcomputers). The Université du Québec à Montréal has developed an original integrated management system for its library services, the SIGIRD system (Système intégré de gestion informatifée des ressources documentaires). This also supports the BADADUQ II (Banque de données à accès direct de l'Univérsité du Québec) system, a collective, online retrieval system serving the Université du Québec library network.

York University has instituted the use of an online computer system in its libraries. Faculty members and students may now access the catalogue through terminals in the library or from microcomputers in the home or office. Library holdings may be searched by subject area, author, title, and other access points. York says that the service has quickly proven to be of great benefit to library users.

The University of Victoria offers library services to its distance students through its INFOLINE services. The librarian can be reached by mail or by twenty-four-hour toll-free phone access and materials sent out or searches done.

Saint Mary's University expects that videodisc and videotex will be used in its library: "Videodiscs are capable

of storing enormous amounts of data, and videotex systems have two-way communication capability. Implementing future technology would have a profound impact on libraries and the consumers of information."

As is the case with other applications of new technologies, there is a variation from university to university in library applications. Smaller libraries find it financially unfeasible to invest in computerization. Most of the smaller libraries, however, provide facilities for use of such technologies as audio- and videocassette players, film and slide projectors, filmstrip viewers, and microfiche.

One of the ways in which smaller libraries can extend applications of new technologies is by sharing resources with libraries of equal or larger size. For example, Mount Saint Vincent is one of a consortium of five universities in Halifax that plans to share computer resources by the Spring of 1985. The other universities are Dalhousie University, Saint Mary's University, the Technical University of Nova Scotia, and the Nova Scotia College of Art and Design. Advantages reported by Mount Saint Vincent include reduction of the amount of necessary investments for computers and software, cooperation in all library activities, merging of catalogues, instant access to resources of the consortium libraries, and better use of acquisition funds.

Mount Saint Vincent makes the following comments:

"Another technology which holds great promises for libraries, especially in the management of archival and vertical file materials is the "data-search" assembly of microfilming, indexing, retrieval and reprography functions all in one station. Bell and Howell have already developed such a system which uses a VAX processor. Its costs are recoverable within a short time through increased space utilization, and through greater staff efficiency. Mount Saint Vincent University already has some of the system components, and anticipates using the technology very shortly.

"The cost of creating machine-readable databases is probably the highest a library faces in computerizing. The creation of a database is indispensable, is labor-intensive, is never ending. For these reasons, smaller libraries find batch services extremely cost-efficient.

"The rapid introduction of computers in libraries, unless accompanied at the same time by vast increases in staff to implement the conversion of the catalog, risks perpetuating a dual access system: one, manual, for older materials; the other, computerized, for current acquisitions. Because of the library users' growing familiarity with computers, older materials which are accessible only manually, tend to be ignored and underutilized. The development of even less expensive utilities for the conversion of old catalog records to machine-readable format is one of the most pressing needs."

The University of Lethbridge has embarked on a project with the much larger University of Calgary to link the libraries of the two universities by computer. The objectives of the project are to provide University of Lethbridge with access to the University of Calgary's catalogued items and government documents; to create a machine-readable government document catalogue at the University of Lethbridge library, using University of Calgary NOMADS software and data; and to investigate and possibly implement record transfer capability between the University of Calgary and University of Lethbridge libraries to facilitate the creation of shared databases. Similar links could be extended eventually to other institutions in the Alberta postsecondary system.

The University of Manitoba mentions a benefit relative to the use of technologies by university libraries: "A few of our technological applications, while perhaps showing a minimal effect in library operations, play a significant role in staff development which, under careful stewardship, can reward both the libraries and the profession in future years."

Memorial University notes the need for balance:

"By its nature a library is a conservative structure. It is viewed as a conservator of important social and cultural values as well as artifacts. Therefore, the acceptance of change, for whatever reason, is never assured, either within or from outside the institution. At Memorial, there is a sufficiently healthy balance within the library to assure that newer technologies do indeed, 'enhance the role of the library' and are not

engaged on a whim. If this balance is respected it will minimize but not eliminate non-acceptance of such changes on the part of the more traditional elements in the user community."

Networks and links among technologies

Queen's University defines "network" as a generic term for an interactive communication system, such as the telephone system. Most new information technology developments involve networking intelligent terminals that can store and process data in verbal, graphic, or numeric form. Networks involving larger computers, microcomputers, and videotex are all under intensive development and operational expansion.[22]

Parkhill refers to merged technology systems as an "Electronic Highway Network with the universal availability of information power that could magnify...the intellectual capabilities of all of us."[23]

Knapper writes in a similar vein:

"...the particular strength of information technology is the ability to combine a system for processing information with a rapid and effective means of communication. The computer is primarily a manipulator of data and its capacity to manipulate has always outstripped its ability to present the results of these manipulations. For instructional [and research] purposes the way in which material is presented is of crucial importance...The technology of displaying information generated by the computer has made enormous strides in recent years... Early examples of CAI made use of slides and videotape to supplement purely verbal information. More recently, videodisc technology has offered the possibility of a much more sophisticated system of supplying visual and auditory information in conjunction with computer-based instructional programs...A second type of information technology that has implications for instruction [and research] is videotex which also combines television and the computer. Users are connected to a central source of information which is relayed to them by means of a telecommunications link such as telephone lines, fibre optic cable or

> satellite...Teleconferencing offers a means of linking students with each other by telephone and visual information can be provided by electronic blackboard, slow-scan television, instructional television fixed service (ITFS), and subsidiary communication multiplex operation (SCMO), an audio medium that uses the space bandwidth on FM transmission..."[24]

Universities are engaging in a number of educational applications based on the networking or linking of technologies, as in computer conferencing, teleconferencing, and videotex. While some of these applications serve on-campus instructional, research, and service needs, others serve distance education needs through satellite, cable, microwave, and telephone distribution.

Computer networking and conferencing. On-campus computer networks linking microcomputers and larger minicomputers exist in many universities. Sending messages among faculty and departments, including libraries, is a useful application of this networking. Electronic mail is the simplest form of computer messaging. Since electronic mail communications do not take place in real time, messages can be sent and received at times convenient to the users. Messaging can be extended to create a computer "conference," which can allow an open or closed discussion among people who sign in using their assigned code. Computer conferences may take place over long periods of time, and between distant locations, and, as with electronic mail, individuals can participate when they are ready. Office, home, or portable terminals are connected through telephone lines to communications satellites which in turn are linked to a central computer. Messages are transmitted via the computer to the terminals of other participants. The messages are displayed on video display terminals or television monitors and may be reproduced in hard copy by a printer. A cumulative record of all communications is available for review at any time. Computer conferencing differs from electronic mail in that conferencing software facilitates group "dialogue" via message storing, search and retrieval, editing, cross-referencing, and report writing.

York University's Faculty of Administrative Studies uses computers linked by cable to allow faculty, support staff, and students to send electronic mail to each other. This

system allows for exchanging information and ideas, working together on a project, and receiving rapid feedback. Course-related communications, such as assignments and schedules, are also managed by this system. To facilitate this and future computer networking, York is investigating the feasibility of installing coaxial cable around the circumference of its large campus into which smaller on-campus cable bands could feed. Simon Fraser University is already linked in this way, as is the University of British Columbia. The University of Victoria also is examining the system's feasibility. The University of Regina and the University of Saskatchewan computer centres have been linked by a computer network for a number of years. This network supports the sharing of common administrative systems and computer access time. The University of Toronto has just developed a local area, high-speed, fibre optic computer network, HUBNET. Athabasca has recently adopted a plan to establish a network of microcomputers in about 30 locations in Alberta for students in administrative studies and computing science. It is expected that this network will be provided with the capacity for interactive CAI in these subjects as well as in others.

The University of Calgary expects that the use of fibre optic cables could replace coaxial cables in the next five years. This would provide high-speed data transfer capabilities between computers in the University's expanding computer network. "A network of mainframe, mini- and microcomputers can create a software rich environment. Faculty and students would have many options and could select the computer from the network that would best meet their teaching/learning objectives."

The Université du Québec is creating an inter-university network among its own campuses and in cooperation with Université Laval and the Université de Montréal. The University of Saskatchewan is developing an on-campus computer communications network that will give students access to printing services, electronic mail, and library services. Faculty and students are encouraged to purchase their own personal computers.

The computer centre of the University of New Brunswick is the host computer location and the administrative headquarters of the New Brunswick/Prince Edward Island Educational Computer Network. The Network includes the

University of New Brunswick (both Fredericton and St. John campuses), St. Thomas University in Fredericton, the University of Moncton (Moncton, Edmonston, Shippegan campuses), Mount Allison University in Sackville, and the University of Prince Edward Island, and has been operating since 1969. It is used for high volume student work, statistical analysis and design, and complex research computing, and has electronic mail and computer conferencing capabilities.

The University of Regina is one of a number of universities where the computer science departments use the UNIX operating system for their computers and share information with colleagues in Canada and the United States by means of a computer network, USENET. (The UNIX operating system allows microcomputers, minis, and mainframes to share programs.) The University of Toronto and the University of Waterloo also state that they have access to North American computer networks for the sharing of programs and other computer-based resources.

The University of Guelph has recently developed a computer conferencing system called Computer System (COSY). It provides an interuniversity message system and has users at all Ontario universities, at McGill University in Quebec, and in Europe. The system is capable of keeping track of messaging among up to 200 users. Guelph is hoping to develop projects to test COSY for distance education purposes, particularly teleconferencing, because telephone data lines are less expensive to use than telephone voice lines.

The University of British Columbia, the University of Victoria, Simon Fraser University, the Open Learning Institute, and British Columbia teaching hospitals are to be linked by high-powered data transmission lines through the facilities of Knowledge West, a partnership of the Knowledge Network and Premier Communications Ltd. The first phase linking the University of British Columbia and Simon Fraser University has already been completed.

Teleconferencing. Teleconferencing, using basic telephone technology which allows more than two people in separate locations to participate in a "meeting," has existed for several decades. The British Post Office's operator-connected conference-call service by which many telephones

could be simultaneously linked has existed since 1934.[25] Over the past 10 years, as businesses and professions realized that teleconferencing was a means of reducing travel, and as it became feasible to link newer technologies such as computers, communications satellites, television technology, videotex, and audiographic technology with the telephone, variations on and additions to the basic telephone conference have evolved. Universities have also seen the uses of teleconferencing and have adopted it to serve distance learners. (In this series, Paper 14 deals with educational teleconferencing in Canada; Paper 15 with teleconferencing in health education and health care; Paper 5 with distance education in Canada.)

There are three major types of teleconferencing:

- Audio-teleconferencing, the most commonly used form, links an instructor to students through regular or dedicated telephone lines by means of an electronic device known as a bridge. The Darome bridge is the one most commonly used by universities and it accommodates as many as 20 link-ups among individuals or centres. Participants in an audio-teleconference can be provided with graphic, written, or videocassette materials in advance of the sessions.

- Audio-plus teleconferencing uses audiographic techniques such as slow-scan video images, computer messaging, and videotex to support the educational purpose. These techniques are methods for transmitting graphic and print information over telephone lines and then presenting them on a monitor.

- Video-teleconferencing in its fullest application is two-way, full-motion, video-plus-audio that gives participants the opportunity to be seen and heard in both locations simultaneously. This form is not commonly used by universities because of its high cost; one-way video and two-way audio is preferred. The video can be transmitted by a number of means - direct microwave, microwave to cable, direct satellite, or satellite to cable.

Through teleconferencing, learners in remote locations, either individually or in groups, can hear a lecture from an instructor or various instructors, interact with an

instructor or seminar leader for individual or group discussion, or interact with one another.

More than 20 universities are using teleconferencing to deliver or augment distance courses. Memorial University foresees that teleconferencing will likely become its primary mode of distance education delivery, with print, audiotape, and videotape used to support teleconference courses: "A teleconferencing course, then, will have the following components:

A. The teleconferencing teacher will meet the students in her or his electronic classroom for one and one-half hours per week.

B. Print, audiotape and/or videotape will comprise the other one and one-half hours of contact time."

Mount Saint Vincent University uses one-way video and two-way audio links in its Distance University Education Program (DUET) program. Interactive credit and noncredit courses are transmitted from a studio-equipped classroom at the University to distance learners. Regular classes are transmitted live via microwave to a Halifax/Dartmouth cable distributor and on the Atlantic Satellite Network transmitting over Anik C3 to cable distributors in Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland. In the present configuration, return links are provided by means of dedicated telephone lines or collect call lines. This allows distance students to participate in the class discussion with the instructor and on-campus students. Mount Saint Vincent encourages off campus students to participate in groups, for example, at their place of work but individual students can call in from their homes. Other educational institutions in the Atlantic provinces that use a similar system include the Atlantic School of Theology and the Dalhousie School of Nursing. The University of New Brunswick, which also uses teleconferencing for distance courses, does not use a Darome bridge but a dial-access bridge developed by the New Brunswick Telephone Company. Acadia University has a dedicated telephone network system for teleconferencing and has had telephone lines laid down for its exclusive use, thus providing twenty-four-hour teleconference service.

The University of Waterloo has experimented with audio-teleconferencing for its correspondence courses, and is considering introducing computer conferencing for distance learners on a trial basis.

Athabasca University, a dedicated distance learning institution, has, for some time, been offering more than a dozen teleconference courses to a large number of locations in Alberta. With the recent adoption of its plan to guarantee the availability of full degree programs in a number of rural centres, Athabasca expects its use of teleconferencing to increase "dramatically" in the next two or three years: "Unlike most other universities that teleconference courses, our delivery in this mode goes hand in hand with the availability to students of very sophisticated printed course packages which greatly enhance their learning experience and thus their completion rates."

The University of Regina writes that its Department of Computer Science and Faculty of Administration used microcomputers linked with one-way video transmission and two-way audio by phone lines to deliver administration courses to sites in the Arctic. "The microcomputers were used to provide, via a data table in Regina and a television in the north, an electronic blackboard." Electronic blackboards convert chalk strokes into digital data for transmission over telephone lines and then convert them back to handwriting for display on a monitor.

The University of Guelph and the University of Waterloo have developed joint graduate programs in physics and chemistry. Guelph says, "A joint task force has studied the desirability of a two-way dual channel video teleconferencing link between the two campuses. The task force is seeking funds to implement this plan which would increase interaction in courses, graduate committees, and faculty meetings while reducing the time consumed in physical travel."

Brandon University indicates interest in establishing teleconferencing as a tool for distance teaching. "We foresee the development of 'learning centres' in rural and remote communities consisting of classrooms equipped with a variety of communication aids including computer terminals, videotapes, videodiscs, and telephone communication with one or several universities." Brandon expresses the following concern:

"Like other small Canadian universities we are using alternative technology to try to make the university accessible to a wider segment of the population within feasible cost limits. We are forced by size and economic reality to collaborate with larger institutions which can afford production units, a wide spectrum of courseware, and high tech equipment; thus we are often the junior partner in new projects. We see a danger that access to higher education for some rural and remote residents of Canada will be restricted to a few institutions which by virtue of their size and government support will tend to corner the market in distance education."

Télé-université, the distance education arm of the Université du Québec, has a teleconference system that allows students to dial in individually from their own homes for teleconferences at pre-arranged times.

The University of Ottawa offers 15 teleconference courses and is experimenting with an electronic blackboard to transmit graphics. The University of Western Ontario uses teleconferencing to teach in several distant centres and is exploring interuniversity teleconferencing. The University of Saskatchewan is using slow-scan video images as a support for teleconferencing in a teacher-training program linking the University and the town of North Battleford in the northern part of the province.

The University of Calgary transmits courses via teleconferencing, including both lectures and discussion, to sites around the province of Alberta. Telidon has been used in conjunction with audio-teleconferencing to display graphic material. Calgary reports:

"The Faculty of Continuing Education has created a teleconference network that involves 20 rural education sites, 33 hospitals and many other ad hoc facilities to provide education and professional development in the many disciplines. Last year the system ran 20 university level credit/non-credit courses (mostly credit courses) through the Off-Campus/Special Sessions office to towns in south-central Alberta. For the Faculty of Social Welfare courses are offered province-wide, in keeping with its provincial mandate for social welfare education. This involved 898 students in courses in the 82/83 academic year and over 5000 participants on the medical

network in 4 one hour sessions a month. The system also carried education activities and series for other educational agencies. Pioneer work in this area in Alberta has led to the creation of 125 teleconference sites across the province involving almost every college, university and educational consortium. The investment in this system has been recognized by three national awards in the area of Distance Education from the Canadian Association of University Continuing Education. The system involves the use of Alberta Government Telephone lines and a computer-controlled bridge which electronically connect together small groups of learners in remote rural centres. The system is totally interactive with the instructor teaching live classes originating on the campus."

In British Columbia, 20 teleconference sites for distance education have been chosen jointly by Simon Fraser University, the University of Victoria, the University of British Columbia, the Open Learning Institute, the British Columbia Institute of Technology, and the Knowledge Network. Both the University of Victoria and the British Columbia Institute of Technology have bridges.

Teleconferencing is recognized by universities as a successful means of adding opportunities for interaction between distance learners and instructors. Ryerson, however, notes that "if teachers are not appropriately trained the teleconferencing of straight lectures can prove to be as disastrous for the learner as the televising of classroom lectures."

Videotex/Telidon. Videotex is an electronic system that encompasses a means of creating text and high-quality graphics that can be stored in a host computer and retrieved through a telecommunications link, at the command of a user at any distance from the host computer, for display on a color monitor. The Canadian system of videotex is called Telidon, and is one of the internationally accepted standards for videotex. Telecommunications transmission of the data may be through standard telephone lines, coaxial cable, optical fibre cable, satellite, or virtually any transmission medium. With a keypad and a decoder the user can gain access to and interact with the stored data. Teletext is similar to videotex, except that a stream of pages is broadcast

continuously and the user selects a particular page for display on the monitor.

Videotex may be used as an information core around which a course can be designed. Information and data can be updated and kept current. Instructors can create their own databases. Videotex can accommodate CAI software, electronic mail, remote database search, lesson plans, inventory, library cataloguing, and financial modelling.[26] (For more information, see Paper 11 on videotex and education.)

Educational applications of videotex in universities vary from on-campus and public teletext systems to the delivery of courseware to distant learners. Some examples follow.

Télé-université combines satellite transmission of video and teletext to provide delivery of course content to computers in schools and homes. Télé-université and Control Data Corporation have produced an interface between the PLATO computer-assisted instruction system and Telidon.

The Faculties of Education and Continuing Education at Memorial University and the University of Calgary offer distance courses to teachers and administrators by linking videotex with the universities' audio-teleconferencing system. Students can see course illustrations on their monitors while they hear the instructor's voice transmitted via telephone and augmented by loudspeaker. Students may ask questions by using microphones. The lecture and the videotex illustrations can be recorded on audio- and videocassettes for student review.

The Université de Montréal Telematics Laboratory is building a database, Agora, primarily for handicapped students. Agora will be available for videotex via the Télécâble Vidéotron cable distribution network.

The University of Western Ontario School of Journalism produces Westex News, a daily videotex news service for the clients of Grassroots (a Telidon service in Saskatchewan, Manitoba, and Ontario, that has information of interest to farmers). Eighty per cent of the content is rewritten and reformatted for videotex from the Canadian Press wire service, and the balance is written by professional journalists who are full-time employees of the school. An elective course on the history and theory of videotex

journalism is offered by the school. Two weeks of training in writing and editing for Telidon systems is part of the students' print course. Westex News is also supplied to AgriStar, an American videotex service. At the University of Regina, students of the School of Journalism produce videotex news items which are sent once a week by computer to the University of Western Ontario where they are incorporated into the Westex News service.

The University of Guelph's Office of Education Development is utilizing the Grassroots database in Winnipeg to provide Telidon services. These services include

- a visual testing aid for first- and third-year courses in neural anatomy. The videotex graphics are transferred to videotape for use in pre- and post-course testing;

- a University Career Planner, a self-paced instructional tool to help students pick courses in biology. Course requirements and entry requirements are listed and the planner is equipped for online registration;

- for VET-TEL, a newly-developed database for veterinarian continuing education. The University ascertained the continuing education needs of practicing veterinarians and developed videotex content to serve those needs. VET-TEL provides the latest information on research findings, therapeutic products, services, events, and upgrading opportunities. The pages are illustrated with color graphics and animation capabilities. VET-TEL also offers messaging, inventory control for clinics to manage supplies, drugs, and equipment, and interactive programs to aid in diagnosing and treating illness.

To cut down on the cost of page creation, mainframe computers, and long-distance telecommunications, Guelph is working on a Computer Assisted System for Education Using Telidon (CASE-T), an on-campus page creation facility for instructors. Guelph plans to expand its educational product base and to market it around the world.

The Computer Communications Network Group at the University of Waterloo has created a campus-wide Telidon service with 30 Electrohome integrated user terminals and a database of more than 1,000 pages. The University also has developed a new software package that offers several unique

videotex services, including electronic messaging. The database includes information on mathematics, arts, correspondence programs, and other courses. The system will also be used to inform visitors and high school students about the University and its programs, to assist lecturers and speakers, and in computer-aided learning programs.

The Canadian Hospital Association is implementing a national videotex system to serve regional hospital associations, and in some cases is joining with university faculties of medicine and with teaching hospitals to create databases and distribute medical and training information.

Combined with satellite transmission, teletext can be a major link for distance education. TVOntario, the Knowledge Network, Télé-université, and the University of Alaska have combined satellite transmission of video and teletext to extend their services and provide free delivery of information in schools and homes. The distinction between videotex terminals and microcomputers is expected to blur, since future microcomputers will contain videotex chips and videotex terminals will become adaptable to general computer applications, in addition to their present role as information receivers.

Using federal government funds, the Interprovincial Association for Telematics and Telidon (IPATT) is establishing a cooperative network of universities, including Télé-université, Montreal, Athabasca, the University of Victoria, the University of Waterloo, Carleton University, and the University of Saskatchewan. The consortium will produce and exchange courseware for use on the videotex system. It is expected that other universities will later join the group.

Another recent videotex project is the Telidon Content Development Program. Under this program, the government of Canada will provide a total of $5 million in assistance toward the development of sophisticated and innovative software and content for Telidon systems. Télé-université has received government funding to create videotex information in three areas: administration and management of courses, electronic editing, and courseware for 20 adult education courses.

The University of Western Ontario has received government

funding to provide educational and research service and general information for full-time students, faculty, and staff, and to extend its news service on the Grassroots database. The Université de Montréal Telematics Laboratory has also received government funding to produce five bilingual multimedia kits to promote Telidon awareness and announce introductory courses in telematics, database development, content videotex, and page creation.

Cable television. Cable television, whether microwave-to-cable or satellite-to-cable, is another technology used by universities to distribute courses to distance learners. The term "telecourse" is often used to apply to a multimedia course that includes television programs (live or on videotape), program guides, curriculum texts, and other course materials. Sometimes the programs are produced specifically for the telecourse by a single university or in cooperation with another university or organization, such as a provincial educational communications organization. Sometimes an existing series of television programs is acquired from another educational or a commercial producer. Curriculum print materials are then built around these video programs. Approximately 12 universities offer telecourses.

Arrangements for cablecasting may be made with a provincial educational communications organization such as TVOntario, ACCESS Alberta, Radio-Québec, Knowledge Network, or made directly with a local cable company. Courses may be cablecast on a channel made available to a university by the cable company, on a dedicated educational communications organization channel, or in some instances on the dedicated community cable channel. In most cases the video program is repeated several times so that students have more chance to view it. (See Paper 10 for a discussion of cable television and education in Canada.)

Several universities have access to province-wide cable networks that include cities or towns - for example, Memorial University, Athabasca University, and the University of Saskatchewan. Universities with close ties to local cable operations include the University of Calgary, the University of Alberta, Carleton University, the University of Ottawa, and Wilfrid Laurier University. Wilfrid Laurier University's courses are grouped into its Telecollege program, which includes degree and diploma courses in more than 13

disciplines. Wilfrid Laurier is working toward the granting of a Bachelor of Arts degree to students who take all their courses through Telecollege.

Lafrance describes the development of the Quebec Educational Television Network:

> "The Université du Québec's Télé-université was instrumental in organizing the establishment of a dedicated educational channel by cable operators in each large urban centre of Québec. Through a two-way connection with the cable systems the various distant campuses comprising the Université du Québec were able to have distributed via cable not only programs which originated on their campuses but also programs produced and recorded at a central office in Montreal. The Video-Network two-way connection between the campuses and the cable companies also permitted inter-city seminars and teleconferences in which students could participate from their homes. Recently, universities outside of the Université du Québec system such as Montreal, Sherbrooke and Laval, and at least one CEGEP have signed agreements with Télé-université and in late 1984 the 'educational channel' becomes the 'Quebec Educational Television Network.' Broadcast time is being made available to some extent by Radio-Québec. A videocassette lending library is a possibility. It can be hoped that technological developments in cable systems will one day permit live contact with more and more specialized target groups. The educational television network will not change the traditional role of either television or the university. It provides for the possibility of a greater audience and thus fulfilment of its mandate for public service."[27]

The Université de Montréal offers continuing education, public information, and home study credit courses on the educational channel of cable systems and on Radio Québec.

By the Fall of 1984, the University of Regina will be using the Saskatchewan Telephone Company's fibre-optics network to deliver classes (administration, economics, computer science) to four remote locations - tentatively Melville, Moose Jaw, Swift Current, and Yorkton. The classes will be delivered simultaneously to a section on campus and the four off-campus locations.

The University of Calgary has been offering telecourses via cable as a member of the Calgary Educational Television Consortium for several years.

The University of British Columbia, Simon Fraser University, and the University of Victoria have been provided with funds to develop distance education courses and professional development courses that will use the Knowledge Network's satellite and cable delivery system.

Memorial University's 40 distance education centres are serviced by microwave-to-cable television complemented by audio-teleconferencing. Memorial expects the teleconference system to expand and hopes to transmit visual material effectively without the use of expensive real-time television by using electronic blackboards and slow-scan video images for distance students. As a service to the general public, Memorial University has offered a popular "playback" service whereby cable subscribers telephone the University to request video programs selected from a catalogue. These programs would then be shown on the cable network.

The University of New Brunswick has been offering both degree and non-degree telecourses via cable television since 1979. The video portion is acquired from the U.S. Public Broadcasting System (PBS) and from Atlantic Satellite Network programming. The University creates the curriculum materials to "wrap around" the video programs. Courses have been offered in psychology, astronomy, and computer awareness.

Instructional television by cable has been successful where it is used. Eventually, as fibre-optical cable comes into greater use, many more cable channels can be made available. Universities' use of cable television can be expanded if appropriate arrangements can be made.

Communications satellites. The first substantial experiments with satellite links for university education were conducted between 1976 and 1979 using the Hermes satellite, which was launched by the United States and operated in Canada. Canadian experiments were sponsored by the federal Department of Communication. (For a full discussion of satellites in education, see Paper 12.) An experimental project was conducted by Carleton University in Ottawa in cooperation with Stanford University in Palo Alto, California, in which

credit courses were exchanged. Classes were transmitted from specially equipped classrooms at one university to students at the other university via two-way audio and two-way video. This enabled video-teleconferencing between groups separated by 4,000 kilometres.

A series of educational experiments using Hermes was conducted by the Université du Québec, which has several campuses throughout the province. These projects included a seminar between the Quebec City campus and the Hull campus, library consultation between remote students and the Rimouski campus library, and transmission of electron microscope images between Quebec and Trois Rivières. In 1977, Memorial University conducted a series of experiments in continuing medical education in which courses originating in the University were transmitted via Hermes to four remote hospital sites in Newfoundland. Teleconsultations were also conducted using slow-scan video. Later, a pilot project using the Anik B satellite further expanded and refined the system. By 1984, educational and health services carried on Memorial's dedicated four-wire teleconference system had been extended to the isolated communities of coastal Labrador, and were available via satellite to the mining region of Labrador West and, experimentally, to a drill rig stationed in the offshore Hibernia oil field.

The educational institutions in British Columbia, in particular the University of Victoria, conducted a series of experiments using the Hermes satellite. These led to participation by the University of Victoria and the British Columbia Institute of Technology in the experiment in 1979-80, in which credit courses were offered in eight locations throughout the province linked by satellite through one-way video and two-way audio. These experiments used the Anik B satellite.

These experiments confirmed the technical feasibility of satellite links in providing one-way and two-way video, and two-way audio links in which real interactivity in learning could take place over distance. They also demonstrated that a variety of traditional educational techniques, such as lectures, seminars, and panel discussions, could be readily adapted for the delivery of distance education via satellite.

An important development from the experiments with Hermes and Anik A and B was the establishment of the Knowledge

Network of the West in British Columbia. The Knowledge Network was set up to provide a satellite delivery network for programming produced by the province's universities and other educational institutions. The University of British Columbia, the University of Victoria, and Simon Fraser University all offer undergraduate credit and professional development courses which are delivered via Anik C3 by the Knowledge Network to distance learners. As an example, the University of Victoria is currently offering a joint distance and on-campus certificate program in computer-based information systems which includes hands-on computer work. Over 65 students are registered in the distance program.

In Ontario, a small number of telecourses are delivered to remote communities via Anik C3, which distributes TVOntario's broadcast signal to low power re-broadcast transmitters (with 85 more to be approved and built) in Ontario's North. Anik C3 also distributes TVOntario's signal to 12 main regional transmitters (with five more under construction) throughout the province and to 25 cable television companies. Through this network, 93 per cent of Ontario's population receives the TVOntario signal.

Recently, the University of Saskatchewan was given free uplink time by the federal Department of Communication on the Anik C3 satellite to transmit live interactive educational programming to Saskatchewan, Manitoba, Alberta, and British Columbia. Cable companies distributed the satellite signal. Applications included continuing education for farmers and veterinarians, nursing education, and teacher training. Information for the general public on University of Saskatchewan engineering programs and on medical and legal subjects was also provided.

The University of Calgary's Department of Communications Media has added a satellite receiving capability to its other services. This has been coupled with an audio teleconferencing unit for satellite-based video events that use two-way interactive audio. Some applications of this experiment are being discussed in the Department of Surveying Engineering which serves the needs of western Canada.

The Bilingual Centre of the University of Regina has directed two satellite projects and is seeking funding for a third. The first project linked the communities of Zenon Park, Saskatchewan, and Baie St. Paul, Quebec, in 1978. The

second project linked the French-speaking communities of Pontex, Saskatchewan, and a small town near Sudbury, Ontario, and included slow-scan video. A project expected for early development would link the University of Regina, the University of Alberta, the University of Winnipeg, the University of Saskatchewan, and the Université du Québec à Montréal, in a telematics network to conduct research into improving communication among francophone groups.

ACCESS Alberta, the Alberta Educational Communications Corporation, will be acquiring satellite service for province-wide delivery of educational services. ACCESS foresees the interactivity of ACCESS Radio CKUA and ACCESS Television by early 1985, to be followed at a later date by the delivery of data, text, and graphic information services, including computer software. The educational services, transmitted via Anik C satellite, will be accessible on educational cable channels in urban areas and available from Direct Broadcast Satellite (DBS) receiving systems to Albertans who reside in remote and underserved areas of the province.

In October 1984, Carleton University will be directly linked by satellite with Edinburgh University in Scotland for two-day simultaneous seminars dealing with the topic of high technology and social change. This experiment is being organized by the Canadian Studies Centres of both universities. The seminar will also be shown on cable television in Ottawa. This will be the first time such a satellite link has been established. The project is being funded by Northern Telecom.

The University of Regina expresses the view of many universities that although the newer technologies hold great promise for education, human and economic factors need to be considered:

> "Interactive capacity [via technology] between instructor and learners may be the link which will revolutionize educational opportunity. Distance may become irrelevant. Satellites, receiving dishes, computers, software and human resources appropriately connected have endless potential. However, this cannot move any faster than the public accepts it, thus the importance of youth and the change in the way [people] may choose to learn."

The University of Saskatchewan points to economic factors that limit applications: "If resources are made available, the use of the newer technologies for distance education will expand. However, the university is having difficulty in sustaining quality on-campus programs because of financial restraints and, therefore, any expansion off campus will be restricted."

Athabasca makes this comment: "While all [the new] technologies are likely dramatically to change the nature of distance education, they are unlikely, certainly in the foreseeable future, to replace the printed course package as the major vehicle of instruction. Rather, they are extremely useful ways of enhancing instruction via the course package for the student who seeks the distance delivery of courses for credit purposes." The University of British Columbia offers a similar statement:

> "It is clear that as new technologies become available effective use will be made of them; however, the tradition of direct instruction and reliance upon print based media is likely to be preferred. As the demand for educational opportunities through distance education develops, new technologies will be utilized as a vehicle for instruction and to help motivate and pace the student. Some of the courses will be of superior quality and will compare favourably with courses offered on campus. Television materials developed for use by distance education students are now being used in on-campus classes."

POTENTIAL IMPACT OF NEW TECHNOLOGIES

Curriculum

The technological age in which we are living is characterized by an accelerated rate of change. Traditionally, preparation for life and work has been the goal of higher education. Further, the focus of higher education has been on building the foundations of knowledge through the teaching of content. From a curriculum perspective, the life of certain knowledge bases could be compressed from decades to years, and in some fields from years to months.[28]

In light of the growing influence of new technologies in society and in university education, universities were asked certain questions. Is there a need to modify the higher education curriculum? Should degree programs in electronic technologies be established? Should the learning of expertise in handling electronic technologies be made a requirement? Should the teaching of "process," that is, problem-solving, creating, and analyzing, be strengthened? Should there be a greater emphasis on the teaching of quantitative reasoning and skills? Some responses to these questions follow.

Saint Thomas More College believes that computer literacy is essential for all students and that incoming students should have their own microcomputers. As for strengthening the teaching of process, the university states, "We must teach students process skills so that no matter what the state of the art in their field they can always acquire new knowledge and skills. New instructional strategies are necessary to allow this to happen. Quantitative reasoning should not be made the total reason for the existence of higher education." Similarly, Université Laval suggests, "computer culture is based on quantitative reasoning but to postulate that everything is quantifible is a fragile assumption."

Memorial University believes that "the teaching of process is important but requires content upon which to operate and that the fundamental understanding of a discipline in the mind of an individual cannot be replaced.

'Instructional developers' and 'content' scholars should together develop and deliver courses."

The University of Regina believes that specialized electronics technologies programs would be useful.

> "They should provide a sound scientific basis and awareness of societal expectations and an opportunity for students to learn how to assimilate information, exercise judgment and make decisions. Society is fast approaching the point - if it's not already there - when an understanding of computers and technology is essential. This is not to suggest that every university graduate should be able to write complex programs or repair technological equipment. Rather, a graduate should have an understanding of how computers work, what they can and cannot do, and the advantages and disadvantages of technology in our society, along with some exposure to simple computer programming."

The University of Winnipeg states, "The university does not wish to require that all students be taught to handle and cope with electronic technology. However, we definitely wish to encourage the use of these technologies and have students literate on their use through integration in current programming." St. Francis Xavier University says, "More will be accomplished by on-the-job training in the use of electronic technology than by formal instruction in its use at a university."

Lakehead University would like instruction in the handling of electronic technology to be both a component of and a teaching aid in existing courses, and adds, "It is no use understanding techniques for transmitting communication if the student is unable to communicate orally and in written form in good English."

The University of Alberta says it would be a mistake to segregate the electronic technologies into special programs. "One of the difficulties with the use of the earlier A-V technologies was that they became the property of A-V specialists rather than being techniques which any instructor might use with appropriate technical help." Brandon University believes that "CAI systems must be made easy for the instructor to create and modify courses. Initial emphasis in CAI should be on the use of retrieval systems by

both teachers and students. Uses could become more complex as sophistication increases."

The University of Prince Edward Island comments, "What is required are courses that explore the fundamental question of the role of technologies in society. The incredible spectrum of 'electronic technologies' could provide a wealth of examples...Although it is tempting to create a new discipline in this area, I believe it is so fundamental and far-reaching it must permeate all disciplines and pseudo-disciplines. We must have not only literacy and numeracy, but also an understanding of science and technology in general."

The University of New Brunswick is planning to set up a committee on institutional planning for educational communications. The committee will investigate the current uses of audiovisual communications and the educational potential of these technologies. The committee will consider, for example, curriculum changes such as combining engineering with the social sciences in a new degree program. Such a program might encompass an in-depth understanding of the elements of telecommunications and its impact, applications, and regulation.

McGill University reports an increased emphasis on both the teaching of process and of quantitative reasoning skills in its Faculty of Education, for example, and also says, "The university itself appears to be putting greater emphasis on procedures and general analytic skills. Two disparate examples are the attention paid to the promotion of 'analysis and synthesis' as a criterion of good teaching and the process of self-study and cyclical review undertaken by the university." The University of Toronto says that "[the teaching of process] already occurs. Such emphasis has increased substantially in recent years, particularly in professional programs."

By and large the majority of universities feel there is at present no need for a specialized degree program or course of study in electronic technologies, and that specialized or advanced knowledge can be handled within communications studies programs, computer science, or engineering. Computer literacy for students is to be encouraged; however, it should not necessarily be required of all students. The teaching of process is already being emphasized in many universities.

The University of Saskatchewan makes a summary statement in regard to higher education curriculum:

> "A university education must develop a genuine sense of inquiry, a desire to reach for truth, exactness and precision, an ability to weigh evidence objectively and intellectual integrity. There are certain 'skills' that must be acquired to achieve this and to 'practice' one's chosen professional career, but over-emphasis on technical skills at the expense of things of the mind must be guarded against in designing curriculum for higher education."

Liberal arts education

A number of universities believe that liberal arts students should have a good understanding of new technologies, but do they believe that overall changes in the direction of liberal arts education will result from these technologies? Opinions in response to this were varied.

The University of Calgary identifies a core issue. "To attempt an answer...one gets caught in the mire of the intellectual debate over the role of the university...is it to educate to a vocation such as law, medicine, education, social work, or do we educate the mind to handle the intellectual processes of life?" The University of Calgary points out that the newer technologies have already changed liberal arts education by making it more accessible, particularly to distance learners. Admissions policies have been altered to admit more mature and part-time students. Nationwide intellectual exchanges via electronic mail, computer conferencing, and audio/video and satellite teleconferencing have been made possible. Multidiscipline courses in liberal arts education are growing.

Simon Fraser University expresses the following view:

> "The newer technologies can do nothing but enhance liberal education. In a futuristic but not unrealistic scenario, the nation's great libraries can be instantly available in your home via your own videotex system; the world's great art will be on a videodisc. In the shorter time frame, library research, cross-referencing, computer

simulations of historical events, etc., will bring new dimensions to the arts and humanities."

The Nova Scotia College of Art and Design sees creative uses for computers in the arts. "As a creative tool, [the computer presents] many exciting possibilities for artists and designers; and as a means of communication the new technology will enlarge the audience for the kind of subjects and expertise a university provides."

Université Laval expects that the individual characteristics of learners will be better correlated with teaching methods as students will be able to make choices about how and with what technological assistance they will learn. The Université du Québec à Trois Rivières says that with the capacity of the computer for storage and organization of knowledge, a learner's imagination will be free to invent new processes of written and artistic expression.

Brescia College of the University of Western Ontario states that "unless care is taken the effect of the new technologies could be damaging," and continues:

> "Advances in computer technology have been made by creative people but the use of the computer itself is far from creative. It tends to limit the use of language (e.g., the single word 'input' replaces a great variety of expressions). The use of several of the new technologies reduces students' familiarity with the printed word. Since the printed word is custodian of the thinking of our civilization in philosophy, in literature, and theology, we are in danger of losing our inheritance through ignorance."

Several other universities express a degree of uncertainty about technologies and the direction of liberal arts education. The University of British Columbia, for example, reports that "it is difficult to say what influence technologies will have. Many feel that the values of liberal education are incompatible with technology but [we] think this is an extreme view." Saint Mary's University says, "the answer to this is mere guesswork." The University of Western Ontario concludes, "It seems that all that is certain is change."

Higher education in general

Three major types of changes were mentioned by universities. The first centred on the concern that new technologies might tend to limit the personal contact between teacher and student. "The new technologies provide a useful aid to personal teaching but [we] would in no way welcome the 'takeover' of the classroom by the computer. In short, there is no substitute for direct student/teacher contact" (Trinity College, University of Toronto). Brescia College says, "The living exchange is vital to the educational process not only for the student but also for the teacher who learns a great deal from his students in stimulating dialogue." The University of Winnipeg says that because of the development of networks there might be less interpersonal contact between students and faculty. Memorial University agrees, but feels that such a tendency can be actively countered by universities:

> "The new technologies will, as they proliferate, create a proliferation of information. Those responsible for higher education will have to ensure even more faithfully than in the past that students are even more soundly educated to deal with the proliferation. There will have to be then an even greater adherence to traditional values of scholarship and enquiry. These values cannot be learned through the new technologies but will be learned in a social manner in the interactions of students with appropriate mentors and each other."

Concordia University says, "The computer will replace (or at least dramatically change) the didactic role of the teacher as craftsman but it will increase the need and demand for the 'evocative' teacher as artist, teaching enquiry and discovery."

A number of universities believe there will be increased demands on faculty with the proliferation of technologies; instructors will need to learn both to use the technologies and to expand their own creative abilities as teachers. The University of Calgary foresees another role for faculty: "There will begin a need for educators to become more involved in the preparation, evaluation and distribution of course material to knowledge databases."

A second type of change relates to the growing importance of distance education. Home study by university students probably will increase, not only through use of the computer for instruction and messaging but through the growth of telecourses via cable television and satellite. Mount Saint Vincent University makes the point that the previous and assumed idea that television had to have a certain "look" about it may be changing. "The fact that nonbroadcast producers such as universities are finding that television can inexpensively serve their needs (and that of the community) has brought about a change in the 'look' of an educational program to allow for more acceptance of telecourses with low production values but high content." St. Thomas More College says that cable television will increasingly be used for distance education, and that the computer will be used for instruction along with videodiscs and videotape: "the dispersion of microcomputers linked with an interactive cable system will open new vistas for education away from the university campus."

A third type of change relates to the impact on universities of increasingly large databases. Several universities suggested that the existence of databases would enhance the development of research in universities and would reduce duplication. Skills will be needed to select from the vast amount of information available. Computer literacy will become an absolute necessity for students, faculty, and administrators, and while courses in the use of technologies are not now a requirement in many universities, they will in all likelihood be so in the future. The Université de Québec à Hull foresees increased collaboration among universities in becoming part of database networks. Brandon University suggests a need to "develop safeguards against unauthorized access and/or alterations to stored data on the part of 'hackers'."

Finally, several universities raised the issue of whether there will be any significant changes in higher education because of the proliferation of the newer technologies. Ryerson Polytechnical Institute, for example, observes:

> "New technologies rapidly become old technologies. Formal educational institutions are slow to adapt and to change. New technologies have had little impact on the process of teaching in the past and will likely have marginal impact on the future. The only possible

exception may be the computer. Educational institutions have developed and will develop specific courses about new technologies, courses that instruct students how to use them, etc., but the use of these technologies in the formal educational system as a whole will likely remain marginal...a computer has become and will become even more so an individual technology, like a calculator. It will therefore have unusual application and this includes classroom or laboratory application, even within institutions. But the real education with computers will go on in the home as will the integration of videocassettes, discs, etc. It will go on under the guise of entertainment, information, how-to-tasks, etc., and only then seep into institutions."

This view is countered by other institutions. For example, the University of Windsor says:

"Some of the traditional modes of teacher/student communication will remain but almost all disciplines will increasingly make use of the newer technologies. Not to do so would ill serve the ability of students to contribute effectively to the technological society of the future."

The Université du Québec à Trois Rivières places the current arguments on the uses of technologies in education in historical context:

"One can't help but remember the arrival of audio/visual technologies which, although they fulfilled some expectations, did not reach full impact because of lack of optimum use. One therefore asks if we don't have a similar phenomenon of temporary popularity [in the case of the newer technologies]. However, while the audio/visual technology was a privileged educational tool, new technology, in particular the computer, is a tool to aid thought, approach knowledge, help the teacher teach and stimulate the participation of the student. If they know how to avoid the enslavement, teacher and student have at their disposal a technology which facilitates their independent/collective interactive relation with knowledge. In universities, where the focus is on the independent/cultural development of the individual, where one aims to have students use critical

minds, we cannot be indifferent to the educational potential of the technologies."

CONCLUSION

While some universities are not in any tangible way using and incorporating technologies in education, the majority of universities included in this report are doing so. Educational philosophy, financial capacity, and faculty, student, and public service demands are the major factors influencing decisions to use technologies. Where a technology or technologies in combination have been introduced to meet existing needs or to render necessary service, and where they can be managed and controlled by their users, they have been most successfully and comfortably used. This has been the case with audiotape, videotape, and computers for computation, administration, research, and library services on university campuses. The need to meet the educational demands of growing numbers of distant and part-time learners and the availability of federal government funding for experimental projects has led to the use of the newly emerging communications technologies such as cable television, satellites, teleconferencing bridges, and videotex.

Universities, like other organizations in our society, are not immune to problems in dealing with conflicting internal and external demands: how far and in what direction to change, what to discard, what to retain, and what to acquire as rapid changes occur. At present, many universities are reconsidering their goals and objectives, re-channelling existing financial and human resources, and searching for alternative funding sources. The tradition of autonomy in Canadian universities is strong, but already there has been considerable cooperative research, planning, and implementation of educational applications of technology among universities, business and industry, and government.

Two recent developments point to further cooperation among universities; first, university presidents meeting at the March 1984 conference of the Association of Universities and Colleges of Canada (AUCC) asked the AUCC Board of Directors to explore further inter-institutional cooperation; university, public, and national library networking; the production of Canadian courseware for Canadian universities; the establishment of national consortia, and sources of funding to expand university use of the new technologies.[29]

As well, the Canadian Society for the Study of Higher Education has made a proposal to the Secretary of State for funding to establish a Canadian higher education research network. This would facilitate research on postsecondary education and promote the effective use of the resulting information for planning and management. The network would link centres of specialization and sets of individual researchers located anywhere in Canada, and would exploit information technology to enhance communications and to produce and disseminate research findings.[30]

In the past year, applications of new technologies in education have increased considerably, especially in linking universities to each other and to their distant students. It appears that this trend is likely to continue. The majority of universities also indicate that their traditional role in "educating the mind" remains of paramount concern.

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APPENDIX I

Communication Technologies and the University

QUESTIONNAIRE

1. Are there tangible changes in teaching/learning methods in your university which were caused by the introduction in past years of film, television/video, radio/audio? If so, in what areas and in what ways?

2. What factors contributed to the use or lack of use of these technologies?

3. To what degree are these technologies still being used or just being introduced?

4. Is there a demand for new program content for film, video, and audio? If yes, explain.

5. In your judgement, could these technologies be more effectively used than they now are in higher education and if so, how?

6. a) To what degree is there recognition and acceptance of the potential of computer-based instruction and instructional services in your university?

   b) Where, in what ways and with what results is your university already using computers, other than in computing sciences, to assist the teaching function of your university?

   c) What strategies and practical accommodation might the university need to adopt to take full advantage of the computer as a teaching tool?

   d) How is the university going to solve the problem of appropriate courseware?

7. a) To what degree is there recognition and acceptance of the role of the computer as an enormous research tool, given the new dimension in data banks, and in the storage and distribution of print, digital, video and audio information?

b) Where, in what ways, and with what results is your university already using computers as research tools?

c) What strategies and practical accommodation might your university adopt to take full advantage of the computer in research?

8. a) To what degree is there recognition and acceptance of the potential for instruction, research, and public service of communication links such as cable, fibre optics and satellites as well as the related technologies of electronic mail, computer conferencing, computer networking, teleconferencing, etc.?

b) Where, in what ways and with what results is your university now using the communication technologies referred to in 8 a)?

c) What developments do you foresee in the use of these technologies at your university in the next five years?

9. a) In what ways and with what results is your university now using newer technologies to provide educational services off campus?

b) What developments do you foresee for the use of the newer technologies by your university to provide educational services off campus, particularly at significant distances from your campus?

10. a) To what degree is there recognition and acceptance of the use of the newer technologies to enhance the role of your library?

b) In what ways and with what results is your university now using the newer technologies in the operations of your library?

c) What developments do you foresee in the use of the newer technologies in your library in the next five years?

11. In light of the increasing influence of new technologies on higher education, is there a need to modify the higher education curriculum in the following ways:

    a) Establish "major" or degree programs in "electronic technologies"? Yes___ No___ Comment:

    b) Require the student in higher education to learn to handle and cope with electronic technology: Yes___ No___ Comment:

    c) Increase emphasis on the teaching of process: (i.e., decision making, problem solving, systems analysis, group dynamics, interpersonal communication): Yes___ No___ Comment:

    d) Put a greater emphasis in the higher education curriculum on quantitative reasoning and skills: Yes___ No___ Comment:

12. What influences will the changes due to the use of the newer technologies have on the direction of liberal education?

13. What significant changes in higher education might follow the present proliferation of new information technologies and in particular of the computer?

APPENDIX II

List of Responding Universities

NEWFOUNDLAND
- Memorial University of Newfoundland, St. John's

NOVA SCOTIA
- Dalhousie University, Halifax
- Mount Saint Vincent University, Halifax
- Nova Scotia College of Art and Design, Halifax
- Saint Mary's University, Halifax
- St. Francis Xavier University, Antigonish
- Technical University of Nova Scotia, Halifax
- University College of Cape Breton, Sydney

PRINCE EDWARD ISLAND
- University of Prince Edward Island, Charlottetown

NEW BRUNSWICK
- University of New Brunswick, Fredericton

QUEBEC
- Concordia University, Montreal
- McGill University, Montreal
- Université de Montréal, Montreal
- Université du Québec, including the Ste-Foy, Montreal, Chicoutimi, Hull, Rimouski, and Trois Rivières campuses, and Télé-université
- Université Laval, Québec

ONTARIO
- Brescia College, London (affiliated to the University of Western Ontario)
- Brock University, St. Catharines
- Carleton University, Ottawa
- Lakehead University, Thunder Bay
- Ontario Institute for Studies in Education, Toronto
- Queen's University, Kingston
- Royal Military College of Canada, Kingston
- Ryerson Polytechnical Institute, Toronto
- University of Trinity College, Toronto (federated with the University of Toronto)
- Université d'Ottawa, Ottawa
- University of Guelph, Guelph
- Université Saint-Paul, Ottawa (federated with the Université d'Ottawa)

University of Toronto, Toronto
University of Waterloo, Waterloo
University of Western Ontario, London
University of Windsor, Windsor
Wilfrid Laurier University, Waterloo
York University, Downsview

MANITOBA
Brandon University, Brandon
University of Manitoba, Winnipeg
University of Winnipeg, Winnipeg

SASKATCHEWAN
St. Thomas More College, Saskatoon (federated with the University of Saskatchewan)
University of Regina, Regina
University of Saskatchewan, Saskatoon

ALBERTA
Athabasca University, Edmonton
University of Alberta, Edmonton
University of Calgary, Calgary
University of Lethbridge, Lethbridge

BRITISH COLUMBIA
Simon Fraser University, Burnaby
University of British Columbia, Vancouver
University of Victoria, Victoria

MAP OF CANADA, showing physical dimensions, provincial and territorial divisions and major cities.